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Getting the Most Out of Your Machine Tool Dollar

By Jerome R. George

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MEN, machines, and materials are the vital parts of the industrial plant. Without attempting to rate them as to importance, let us admit their interdependence and the dependence of industry upon all of them. If we mishandle these vital parts of industry, or any one of them, we are wasteful. Good machines must be provided, good men must be engaged to operate them under correct working conditions, and the material factor must be carefully looked after in order to secure the best results from men and equipment. I have something to say about all three, because all of them affect the results obtained from the equipment dollar.

To me it seems that in our plant, where the product is rolling mills and wire-drawing machinery, the equipment problem is complicated when compared to the same problem in a production shop. It will not be disputed, however, that in general there is one problem which is the same in all shops, namely, to buy the equipment that will return the greatest profit. With us the complications arise because of very short runs and differences in design among the many kinds of machines that we build. In a developing business a machine that is the most efficient for the job to be done today may not be the ideal machine for tomorrow's work, and a compromise is necessary. It is impossible to adopt a formula because the parts to be machined constitute an unruly variable.

No Time Limit for Return of Investment

Because of the difficulty just outlined we follow a general policy, which is in effect to keep informed of all new equipment and to spare neither time nor expense in purchasing such equipment as will enable us to secure the best investment, as nearly as it can be determined. In line with this policy, it is apparent that we cannot set a time as the maximum during which any machine bought must return the initial expenditure from increased earnings.

The age of a machine is likely to be indicative of its degree of usefulness. At the present rapid rate of development in design, a machine tool that is ten or twelve years old is probably a back number. The chances are that it is not sturdy enough to stand up to the cuts that are expected in modern practice, and that can be taken by the modern cutting tool. Or it may not be able to live up to the requirements for accuracy, which are constantly reaching higher standards. Finally, it is difficult to secure the greatest interest of the operator in his work, when he is handling a machine that is out of date.

Standard Machines Bought When Available

Any one in the organization has the privilege of recommending the acquisition of a machine. Knowledge of the existence of new equipment is secured through the usual channels that have been mentioned in earlier articles in this series. Conviction that we need new equipment arises from a comparison of the features of new machines available with those of older equipment in the plant, or because of a study of existing methods that offer opportunities for improvement. If no tool is available for the work we desire to perform we sometimes design and build one for the purpose. If standard tools are available, and they usually are, they are bought.

Every recommendation goes first to the "plant committee," made up of leading foremen and superintendents and presided over by the general manufacturing superintendent. The recommendations of the plant committee go to the "manufacturing committee," made up of the heads of all departments, including purchasing and engineering. The manufacturing committee makes its recommendations to the board of directors, by which the question of making the investment under consideration is settled one way or the other. The same procedure is followed with respect to the elimination of old tools, which, upon being discarded, are traded in or scrapped.

We try to have the sifting done by the plant com-

Working Heights of Machine Tools and Wood-Working Machines

Kind of Machine	Height in Inches from Floor to Top of Table											
	Up to 24 In.	30 In.	36 In.	42 In.	48 In.	54 In.	60 In.	6 Ft.	7 Ft.	8 Ft.	10 Ft.	12 Ft.	14-Ft. and Larger
Planers, closed and open-side, of the same table width*	34	32	30	28	26	24	24	22	22	20	20	16	16
Milling machines, planer type*	34	32	30	28	26	24	24	22	22	20	20	16	16
Boring mills, vertical*	34	32	30	28	26	24	24	22	22	20	20	16	16
Boring mills, horizontal	30	28	28	24	To have table at floor level								

Milling machines, other than planer type, height from floor to center of Spindle—Usual sizes	48	Radial drills, height from floor to top of table	4
Large machines	52	Swing saws, height from floor to top of table	30
Grinders, internal, height from floor to center of spindle	42	Buzz planers, height from floor to top of table	34
Grinders, cylindrical, height from floor to center of spindle	40	Cylindrical planers, height from floor to top of table	34
Lathes, engine and turret, height from floor to center of spindle	42	Rip saws, height from floor to top of table	34
Shapers, height from floor to bottom of ram	42	Saw benches, single and double, height from floor to top of bench	34
Gear generators, bevel, height from floor to center	40	Core box machines, height from floor to top of table	34
Gear Generators, cylindrical, height from floor to center	36	Band saws, height from floor to top of table	42
Slotters, vertical, height from floor to top of table	30	Lathes, speed, height from floor to center	42
Gear Hobbers, height from floor to top of table	28	Gap machines, height from floor to center	42

*The heights given are in some cases believed to be about 2 inches higher than required for greatest operating efficiency, but have been so chosen for the convenience of the machine tool builder.

mittee, which is held responsible for production. When the machines of two or more manufacturers are considered, from which one will be selected, they are gone over point by point. Sturdiness, method of lubrication, convenience and safety of operation and method of drive are some of the more important points that are kept to the front. Our previous experience as to productiveness and amount of repair affects our attitude toward machines under consideration.

When we feel that our own judgment may be based on information that is too meager, we invite the salesmen of the respective machines to talk to the plant committee or the manufacturing committee, only one manufacturer being represented before a committee at a time. Men from the shop, who have the closest contact with the machines, also sit in at the meetings when it is thought that their presence will be of benefit.

The statements that I have made apply to both replacement machines and machines bought to give additional capacity. In buying for replacement we never experience any difficulty in securing better equipment, and that condition holds true in buying for additional capacity when we have had the same or a comparable job to deal with before. Not long ago a new job came up, for which we had equipment that would turn out the work, but not to the best advantage. Our problem was whether to buy a milling machine especially suited for that job or get along with what we had. Believing that the job would recur frequently, we bought the machine, and, as it turned out, were well repaid for doing so. Had the job not repeated at intervals there might have been another story. I cite this case to illustrate my point that the equipment problem is complicated in direct proportion to the variety of the work that must be machined upon it.

So much for our methods of selecting and buying equipment. The importance of the how, why, and when of securing equipment being established, it is advisable to consider how it is to be used to get the most out of the dollar invested. I want to emphasize two points, the working heights of machine tables, and the number of working hours per week.

In rolling mill equipment the closest attention is given to the working heights of all the different machines, and it was because of that fact no doubt that the question of the working heights of shop tools came to my attention, with the result of the establishment of a definite practice in our own shops. For example, we have set large planers and boring mills so low that the operators can step easily from the floor to the tables.

The proper height of a table is the height at which the operator can do his work with the least effort and with the least danger. Platforms and steps are far from desirable, because of risk and fatigue to operators, difficulty in cleaning, bad appearance, and, reduction in output. Especially is this true when an operator tends more than one machine. When operators move from machine to machine, or from shop to shop, working conditions will be more nearly uniform when the table heights of similar machines are the same.

Many machine tools are designed with the tables too high, especially the larger machines, but the user can almost always remedy the defect without very heavy expense or great alteration, by setting the bases below floor level. The accompanying table shows our practice.

Now in regard to the number of working hours per week. We believe that we cannot afford to work our machine tools on the usual single-shift basis, or our men on the usual day and night shift basis, so we have evolved another plan that has been effective for several

years. By it we keep our machines in operation eighty-eight hours per week, or 4,500 hours per year. Our men work in two shifts, one of which goes to work at 6:30 a.m. and exchanges places with the second shift at 2:30 p.m. The second shift continues on until 11:42 p.m. With 24 minutes out for each shift for a meal, and the first shift working up to 12 noon on Saturday, each shift works forty-four hours per week. There is no work required on Saturday afternoon, Sunday, or on any week day between midnight and 6:30 in the morning.

There are several advantages to this plan:

It keeps our overhead costs below what they would be if we worked our machinery only forty-eight to fifty-four hours per week.

It keeps down our investment in equipment.

It permits us to get the most return out of our machines during the years while they are still modern—that is, before machines of better design are available to supercede them.

It appeals to our men. They like a forty-four-hour week. As the plan works out, the younger men prefer the second shift, which provides the longer working period, but also the longer week end (from 11:42 p.m. Friday until 2:30 p.m. Monday). The older men prefer the first shift, with the shorter day, but something to do every day. Every man has approximately a half day of daylight every day and sleeping in the hottest part of the day is unnecessary. Gardens and lawns can be tended to regularly, during the daytime. Every man has his opportunity to go to the bank, hence we can pay by check. The men of our plant are going to and returning from work during the off-peak hours of local traffic. Finally, we are able to secure an hour of overlapping supervision, the foremen of the first shift staying on a half hour after their men are through, and the foremen of the second shift coming on a half hour ahead of their men.

In order to maintain as nearly as possible continuous employment of our men and machines, we have for many years followed the practice of contracting out our peak loads, placing them in other shops, where men and tools would otherwise be idle. When the volume of our manufacturing requirements falls off we do not feel the effect in our own shops unless the reduction continues for a longer time than is likely in this country under ordinary political conditions. If, and when, our business falls below the producing capacity of two shifts, we can reduce to one shift working fifty or fifty-four hours and carry on as economically as the average shop.

Simplification

The proper selection and the simplification of materials has been of vast importance in keeping our machines working with the least confusion and with the least change of set-up. With respect to our own product we have thought our experience warranted us in eliminating many of the sizes and designs of machines sometimes called for by the steel trade, and this we have done with the usual economies resulting from simplification.

Since the Department of Commerce has taken up the work of standardization and simplification of the products of industry, we have been following and assisting the work as much as possible. For example, we use great quantities of angle iron. In that item alone we have reduced the sizes, as measured by sections, from seventy-four to eleven. Doing such things has worked no hardship. In fact it has been a big help to both the shop and engineering department, by saving room and preventing confusion in the former and by narrowing the field of selection in the latter. The investment in goods in process and in stores has been reduced, and we are able to place more attractive orders with the mills and warehouses.

When it is down in black and white our plan of handling shop equipment problems does not seem to me to differ much from the plan that the average non-production shop would naturally follow. I hope, however, that I have been able to contribute something of interest to this valuable series of papers by directing attention to some of the collateral features having to do with the problem of getting the most out of a machine tool dollar.

[The preceding article is the fifteenth under the title, "Getting the Most Out of Your Machine Tool Dollar." The first article, by J. A. Smith, General Superintendent of the General Electric Co., Schenectady, N. Y., was published on page 409, Vol. 62. The second, by C. A. Shaffer, General Supervisor of Machinery and Tools of the Illinois Central Railroad, was published on page 521, Vol. 62. The third, by Robert F. Runge, Vice-president of SKF Industries, Inc., was published on page 719, Vol. 62. The fourth, by L. C. Morrow, Managing Editor, *American Machinist*, outlining the policies of the International Harvester Co., was published on page 793, Vol. 62. The fifth, by G. T. Christopher, Factory Manager, the Dayton Engineering Laboratories Co., was published on page 907, Vol. 62. The sixth, by D. C. Wright, of the H. W. Caldwell & Son Co. plant of the Link-Belt Co., was published on page 1, Vol. 63. The seventh, by T. C. Vail, superintendent, the Spicer Manufacturing Co., was published on page 175, Vol. 63. The eighth, by E. R. Norris, director of works equipment, the Westinghouse Electric and Manufacturing Co., was published on page 255, Vol. 63. The ninth, by Fred H. Colvin, Editor, *American Machinist*, was published on page 417, Vol. 63. The tenth, by Wm. Bailey, production manager, the Hoover Co., was published on page 917, Vol. 63. The eleventh, by G. S. McKee, assistant factory manager, the Timken Roller Bearing Co., was published on page 995, Vol. 63. The twelfth, by Wm. Hartman, superintendent, the National Cash Register Co., was published on page 1, Vol. 64. The thirteenth, by Percy S. Brown, works manager, the Corona Typewriter Co., Inc., was published on page 183, Vol. 64. The fourteenth, by M. H. Westbrook, shop superintendent, Grand Trunk Railway System, was published on page 261, Vol. 64. Other articles on the same subject will be published in forthcoming issues.]

Photographs for Drafting Records

By John F. Hardecker

"Seems to me," mused Jack Smith to his fellow chief draftsman, Bill Smith, as they were returning from lunch, "as though I'm running a sort of booking agency these days in conjunction with our drafting work. You see, we're just cleaning up on several comparatively small and special installations around town, and I've got to keep sending out draftsmen to get the dope and check up on drawings so as to bring them up to date and complete our records. Its not that the changes are important, but we do try to adhere to the policy of having our drawings 100 per cent correct when the job is finally installed."

"Well," replied Bill, "I used to have the same problem, but now I can clean up the same proposition in several hours, and really have a valuable record. I use a commercial photographer, however, to good advantage. I arrange to send him out with the draftsman who is familiar with the job, and in an hour or two, they take all the necessary photos to complete the record of the actual installation. These photos make a really valuable record. In fact, in the case of the Premier Co., which as you recall was destroyed by fire, there was a question as to compliance with fire regulations in some installations and it was our photographs which convinced the fire underwriters that we had fully complied with the code. Much more readily and effectively, the Premier lawyer assured us, than any drawings might have done. There's only one temptation to resist, that of using an amateur photographer."

"Give References and State Salary Required"

By D. Wright

HOW often does the wording along the above lines greet the eye of one perusing the classified columns of a periodical, looking for an announcement that may eventually lead to a position? I wonder whether the harm done through the use of this form of advertisement doesn't far outweigh any possible good that may accrue. In other words, wouldn't it be better all around if such requests were left out of the advertisement and the space devoted to setting forth in more detail the requirements of the particular job advertised.

In the first place, what is a reference?

Unless the writer's impression, derived from a number of years' contact with employment problems, is at variance with the truth, what is really desired consists of a sincere, unprejudiced exposition of the candidate's abilities and shortcomings from the point of view of one who has already had him in his employ.

A Burden on Executives

Now, assuming that our candidate under consideration has left a position in good standing with the executives. Is it fair to these executives to ask them to write references in reply to requests from a number of sources? Wouldn't it be better if no investigation of personal references were made until a candidate had satisfied the prospective employer of his fitness for the position under consideration on all other counts? Might not such a procedure gradually improve the standard of all references, lifting them from the ruck of commonplace formality to the higher plane of honest analysis?

Then, instead of receiving requests from a lot of people for references regarding a certain individual, to which ordinary fairness dictates that proper answer be made, a request will only be made when the favorable or adverse form of this reference is to be made the deciding factor in a final selection.

I have definitely adopted the policy, when engaging a candidate to fill a vacancy, of forming a very definite opinion as to his or her fitness for the job prior to following up any references, so that nearly as possible the ultimate engagement or rejection will hinge upon how the references impress me upon their arrival.

On the other hand, should I seek for myself a new connection, it would be a definite part of my plan to endeavor to so "sell" myself to the prospective employer that any reference I might offer would merely be used to confirm my apparent fitness.

I am sure that such a course will not only assure me of a much more enthusiastic and sincere testimonial, but will impose a minimum of work upon the ones to whom I refer.

Now, for the second point in the quotation which opens this article:

How much good does it do to bring the salary question into a "blind" advertisement? It is quite possible that since the employer knows the conditions surrounding the proposed employment, the living costs, the rents, the opportunity for indulgence, etc., and is in a position to know a fair price for the work, he can help matters along very materially and eliminate a lot of unnecessary correspondence by frankly stating the limits to which he is prepared to go in this matter.

At first thought many employers will object to such a procedure, believing that it will preclude the bargaining possibilities which the average man likes to feel exist in any proposition which involves the expenditure of his money.

On the other hand, because of the blind nature of the advertisement, some are prohibited from exercising intelligent preliminary judgment, which might save a lot of wasted effort; and because they do not wish to overlook a single chance that might possibly lead to a connection, they place their application, naming a figure which they strive hard to make conservatively in line with what they guess the other party might meet.

The point of the whole thing is that, without any knowledge of the locality of the position advertised, the applicant is at a loss to know how to base his proposition.

The employer has within his business program certain tasks or responsibilities that he wishes to delegate to someone other than himself, and with the requirements of these tasks before him, together with such limitations as may surround them, he seeks to engage someone who from all available evidence appears to meet the specifications.

The applicant, on the other hand, seeks the opportunity to apply such skill, experience and knowledge as he may possess amid the elements of what goes to make up good working conditions, coupled with a financial return that will enable him to establish and maintain a home life of the same or better standard than the one to which he and his family have been accustomed.

Limitations of Salary

The first of these two has nothing to do directly with the wage return to the man.

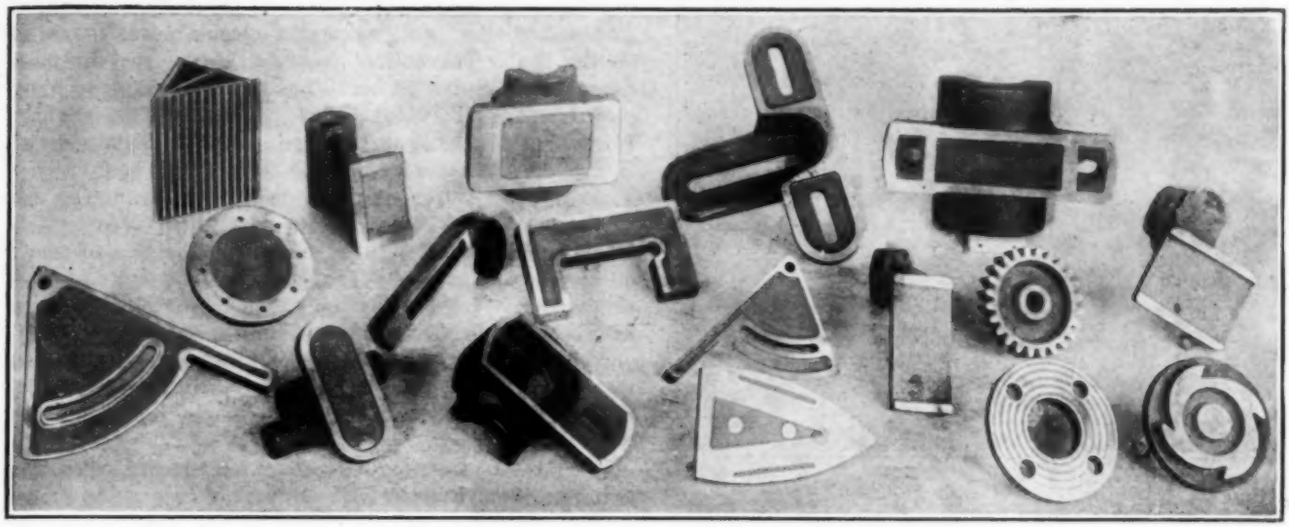
The second, however, is of vital importance to anyone seeking a position, and, assuming that the first will help to hold an employee once he becomes a member of an organization, it is the assurance of a satisfactory settlement of the second that will prove the deciding factor in attracting the outsider.

If the matter of salary must be included at the outset, let the employer state frankly the limitations, at the same time endeavoring to prove the fairness of this limitation on the basis of local conditions.

Certain it is that once a statement relative to a salary figure appears in an application, it creates an impression which may reflect against the writer should it fail to coincide with the figure that the advertiser has in mind. Under the impression that the applicant, who names a $600 monthly salary, would be unquestionably dissatisfied with a remuneration of only $500, the tendency is to eliminate this man from consideration, entirely ignoring the fact that the conditions surrounding the position in question may be such that the $500 figure will in all probability provide as much or more in the way of living standards as the higher figure is at present obtaining for its recipient.

Summing it all up, there is a question as to whether or not the form of advertisement that appears over a "blind" number and brings into forced prominence the two elements of personal references and a premature naming of a salary figure is not worthy of serious study by advertisers with a view to changing the text.

It is the writer's opinion that a change along the lines suggested would work out to the mutual advantage of all concerned.



Modern Applications of Disk Grinding

By Frank W. Curtis
Western Editor, *American Machinist*

A variety of examples of work being successfully ground on hand, semi-automatic and automatic grinding machines

MODERN grinding equipment for disk and face grinding provides quick and economical means of surfacing flat work of a varied nature. Both small and large parts can be ground on one side only with the simpler types of machines, or ground on two parallel, opposite surfaces with the double-spindle grinders. Machines for this class of work are made for hand, semi-automatic or automatic operation.

In selecting a machine for a given piece of work, the size and desired finish of the component and the production required are the most important factors to consider. If the work is produced in quantities sufficient to warrant the continuous use of a grinding machine, there are several ingenious ways of handling that will afford high production. For this type of work the machines generally are equipped with work-holding and feeding devices of special design that make the machine a single-purpose type. When a variety of work is to be handled on a single machine, the procedure differs in accordance with the nature of the work. The selection of a grinding machine for such work must be made with care so that each unit can come within the scope of the machine and yet permit handling in an efficient manner.

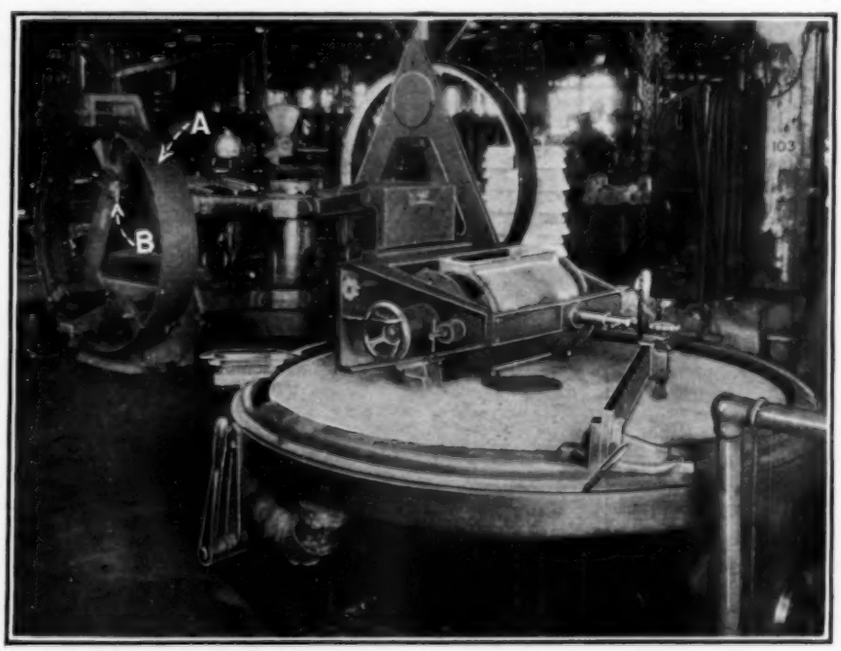


Fig. 1—Continuous-feed disk grinder

The amount of metal on flat surfaces to be removed by grinding should be held to a minimum, and the surface to be ground should

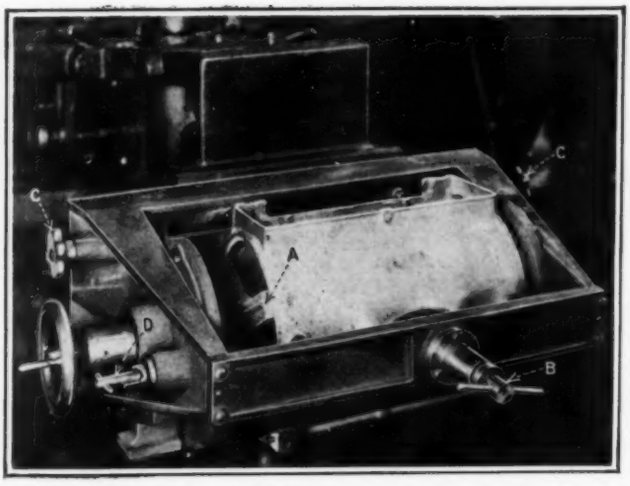


Fig. 2—Close-up of fixture for scale cylinders

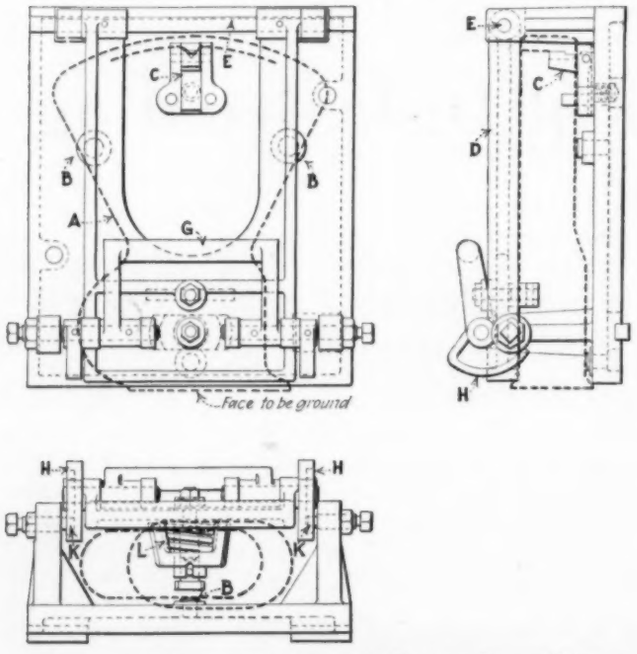


Fig. 3—Fixture used for grinding scale castings

be provided with relief wherever possible, without affecting the service that the part is expected to render. Examples of the design of such flat surfaces are shown in the headpiece, where it may be seen that the ground surfaces are small in comparison to the size of the work. In most of the examples shown, the surfaces to be finished were considerably larger when handled by other methods.

The example of continuous-feed disk grinding shown in Fig. 1, illustrates the method used in grinding parts of a portable, automatic scale at the plant of the Toledo Scale Co., on a No. 24 Gardner machine. The fixtures used for holding the work are mounted on brackets attached to a reel that may be rotated at speeds ranging from ¼ to 1 r.p.m. The brackets are mounted by two pins to provide a swinging action that is controlled by rollers fastened to the brackets and a circular cam mounted on the reel. The action produced as the reel revolves causes the fixtures to be automatically lowered as they pass the abrasive disk, after which the cam slightly raises the brackets and fixtures for the remainder of the revolution where reloading is accomplished.

As the production required does not warrant the use of the machine for any certain part, the procedure followed is to mount fixtures for various styles of work on the brackets. Cast-iron housings and cylinders of several sizes are handled on the machine shown. The housing *A* is located from the back face on three hardened blocks and is held in place by two sliding clamps located over two of the blocks. A pin in the lower portion of the fixture and the spring plunger *B* locate the work radially.

A close-up view of the trunnion fixture used for grinding the cylinder casting of a counter scale is shown in Fig. 2. The work is placed in the fixture body so the center hole fits over a stationary locating plug at the right-hand side, after which the adjustable plug *A*, operated by the handwheel, is tightened against the opposite side of the work. The locating portions of the plugs are tapered to centralize the work and to simplify removal. The plunger pin *B*, that fits into a cored hole of the work, is used to locate the cylinder radially before it is clamped tightly in place. The plunger is withdrawn after clamping has been accomplished. When one side of the work has been ground, the trunnion clamps *C* are loosened and the index pin *D* is withdrawn, thereby permitting the work to be turned for the grinding of the next face. Three sides are ground at one setting. On both the housing and cylinder castings approximately $\frac{1}{32}$ to $\frac{1}{16}$ in. of metal is removed. The work is revolved at the rate of one revolution in 2 min. The abrasive wheel is a heavy-duty Gardner GIA disk, 53 in. in diameter, revolving at 500 r.p.m. The grinding is accomplished dry.

The same machine is used for grinding housings of small candy scales, utilizing the fixture shown in Fig. 3. The work *A* rests on three locating blocks *B* while the radial location is maintained by the spring-operated V-block *C* that fits against a boss on the work casting. the cam-locked clamp *D*, pivoted on the pin *E*, is swung

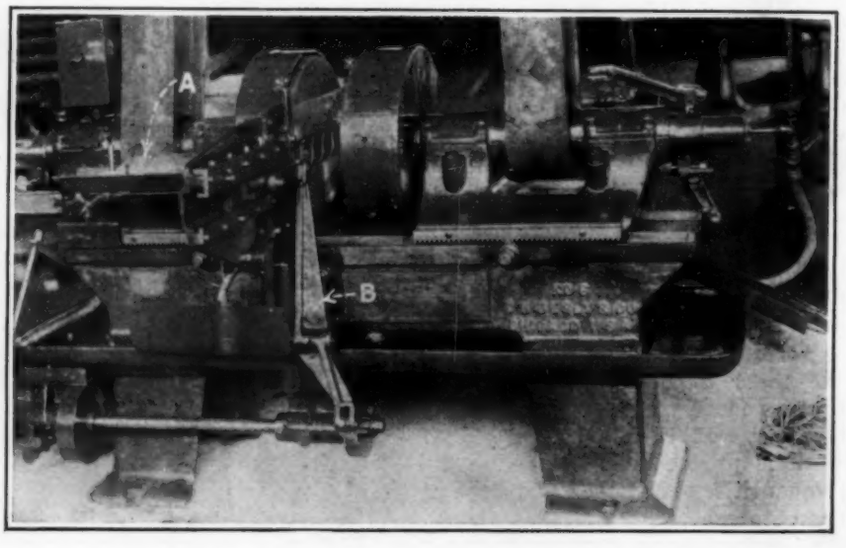


Fig. 4—Piston-ring grinding machine

over the work in the position shown, then locked by raising the handle *G*. The cams *H* are grooved to receive the hardened pins *K* that are located on the fixture body. To compensate for variations in the work, the locating and clamping portion of the clamp is provided with a heavy spring *L* so that work will not be distorted or cracked in the event the operator applies too much pressure through the cams. The fixture is clamped to one of the revolving brackets, the vertical location of which is determined by the key in the fixture base. The work is ground at the rate of 90 pieces per hour.

For the grinding of work to be finished on opposite sides, the double-spindle disk grinder generally is used. These machines are adjusted so the distance between the wheels corresponds to the size desired for the finished work. When heavy cuts are required, the spindles are arranged so the gap between the abrasive wheels increases slightly as the work is inserted; then as the surface of the work is removed the spindles close together to a predetermined stop by means of weights.

Grinding Piston Rings

An example of an automatic grinding operation, handled on a No. 6-20-I Besly machine, is shown in Fig. 4. The operation is the rough grinding of individually-cast piston rings, 3⅝ in. in diameter, of 3⅛-in. bore and 0.131 in. in thickness, requiring the removal of from 0.005 to 0.006 in. of stock on a side. The permissible tolerance is 0.0015 in. Approximately 150 rough-cast rings are placed in a V-shaped trough shown at *A*. A weight is used to force the rings against the feeding fixture so that the arm *B* can pick up one ring at each stroke. The rings are fed between the wheels, being guided by two rails that are smaller in thickness than the width of the finished ring. The rings pass through the abrasive wheels to the rear end of the machine and into a chute from which they roll to the box shown at the right-hand side. The wheels are shown separated to illustrate the guiding rails. As each ring is started between the abrasive wheels a special cam-operated device is actuated to slightly open the gap between the wheels.

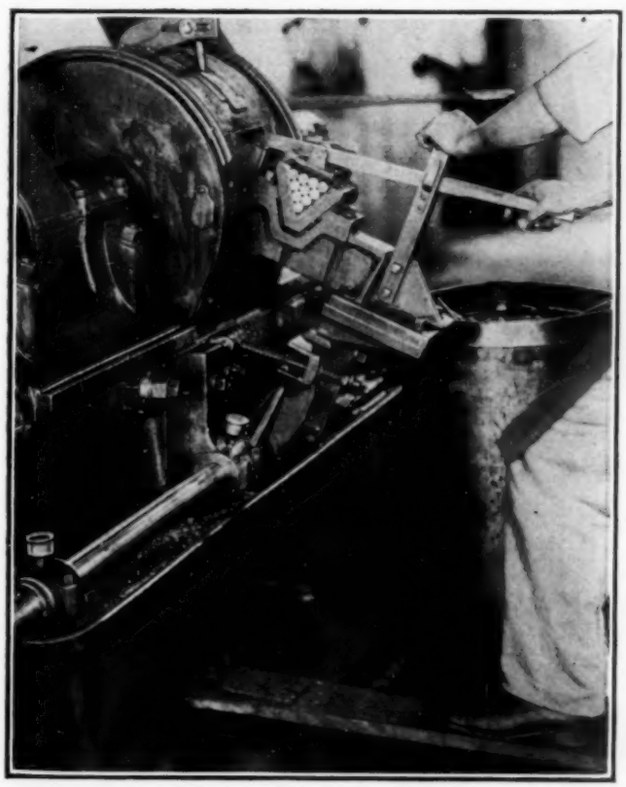


Fig. 5—Grinding ends of bar work

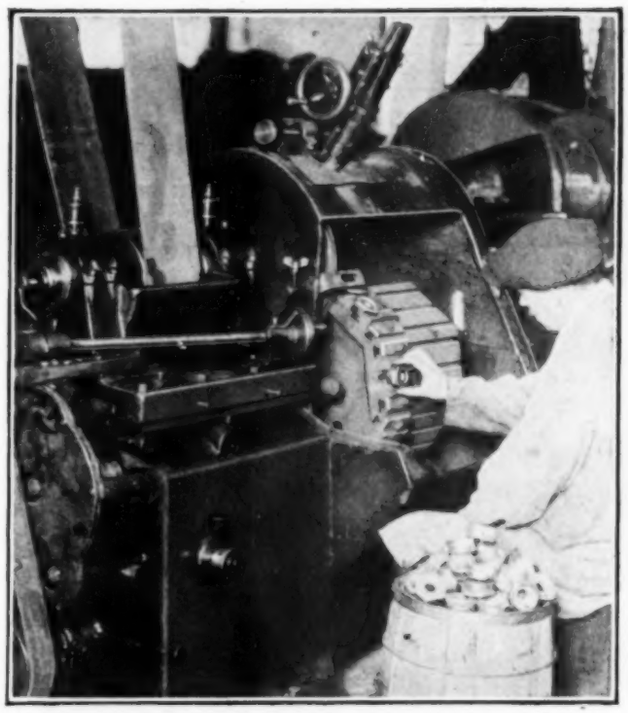


Fig. 6—Drum-type feed disk grinder

Fig. 7—Grinding die blocks

Each of the abrasive wheels, 20 in. in diameter, consists of a steel disk with ¼-in. thickness of No. 24 grit Crystolon, made waterproof for wet grinding. The wheel requires dressing approximately once a day of 8 hr. A dressing device, attached to the rear of the machine, is used for truing the wheel faces. The wheels operate at a speed of 900 r.p.m. The production obtained is 32 rings per min. After this operation, the

rings are finish ground, requiring the removal of 0.003 in. on a side. This type of machine also is used for grinding disk washers, radio magnets, ball races up to 5 in. in diameter and similar work having parallel surfaces up to 12 in. in width.

This form of grinding also may be handled by hand-operated machines although the comparative production will be somewhat less. An operation suitable for hand grinding, shown in Fig. 5, is the grinding of both ends of a set of tap blanks on a Besly grinding machine. Ten pieces are inserted in the V-type fixture and held in place by the clamp *A* as shown. As the work is inserted between the wheels, the operator forces down the treadle that closes the abrasive wheels against the work, thereby centralizing it in the fixture. The treadle is actuated until the wheels have come to a stop that is set in accordance with the width of the work required. The tap blanks are high-carbon tool steel, $1\frac{1}{16}$ in. in diameter, $5\frac{3}{4}$ in. in length, requiring the removal of approximately $\frac{1}{64}$ in. of material on each end. A tolerance of 0.005 in. is permitted. The production obtained is 275 pieces per hour. Ring wheels, 18 in. in diameter with a 4-in. face, No. 16-L alundum, are used.

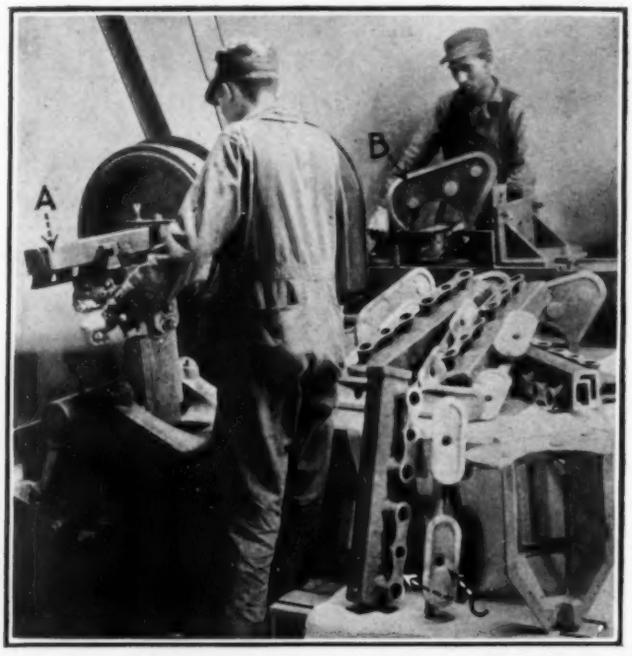


Fig. 8—Combination grinding machine

Semi-Automatic Grinders

Another form of disk grinding, shown in Fig. 6, is handled on the drum-type machine that is semi-automatic in operation. The illustration shows the method of grinding malleable-iron radiator nuts on a 16-in. Gardner machine. The nuts are hexagonal, but are ground on one side only to remove the gate. The work is placed in a receiving fixture on the drum that revolves in an upward direction. A strap band is used to hold the work in place as it passes the face of the wheel. Eight fixtures are mounted on the drum that revolves at 2 r.p.m., thereby giving a production of 960 pieces per hour. An 18-in. disk wheel, No. 245 Gardner GIA, operating at 1,400 r.p.m., is used. As the work does not require an accurate finish it is not necessary to dress the wheel face. The average life of the wheel is 60 hours. The machine is used for a variety of work, the size of which is governed by the capacity of holding

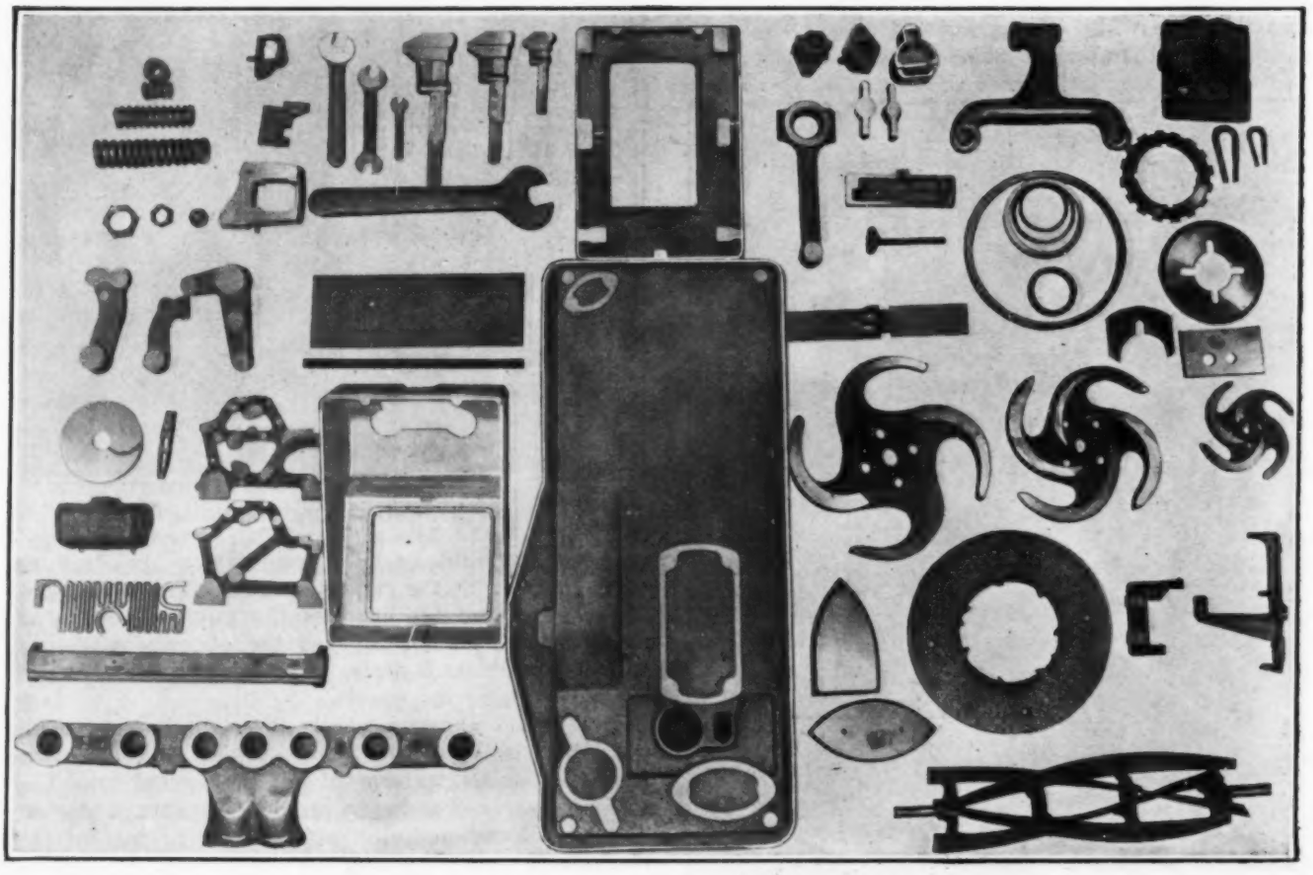


Fig. 9—Variety of work ground on disk grinders

fixture that can be mounted on the revolving drum faces.

The machine shown in Fig. 7 is a Gardner Oilgear-feed double-spindle disk grinder set up for grinding high-carbon tool-steel die blanks. The blanks are ground on the sides and edges to 3x2½x1 in. in size. For the grinding of the edges, three pieces are mounted on the Oilgear-operated sliding workrest and passed between two 18x3-in., No. 16-J Alundum abrasive wheels that operate at 1,150 r.p.m. The sides of the work are ground two at a time, these being held in a similar manner. Approximately $\frac{1}{32}$ in. of metal is removed; the finish sizes are held to 0.0005 in. An oil lubricant is used on this operation as a coolant and compound. The life of the wheel between dressings averages 45 min. The production obtained is 60 completed die blocks per hour.

Combination Grinder

In addition to the machines shown there are other designs being marketed that are suitable for pieces of various shapes and capable of producing work of high or low production. Among these is the Badger combination grinder, illustrated in Fig. 8, that is a combination of a lever-feed oscillating table-type machine shown at the left-hand end and a hand-feed face grinder at the right. The unit is used for surfacing a variety of automotive castings that are handled in quantities of fifty pieces. The manifold at *A*, held in a simple fixture consisting of three locating points and a strap clamp, is being ground on one end; the production is 120 pieces per hour. The transmission-case part at *B* is ground on two faces that are at right angles to each other, a finished piece being shown standing at the lower right-hand corner.

A number of pieces are ground on one side after which the fixture is changed over to receive the work for the grinding of the additional side. The average time is 2 min. for each surface, permitting an average production of 15 pieces per hour. The pieces shown at *C* also are handled on the same side of the machine, the time for finishing being 1½ min. each. These pieces and the transmission part must be ground to a straight surface within 0.003 in. A 25-hp. motor is used for operating the machine.

An idea of some of the work that is being ground successfully on disk- and face-grinding machines may be seen in Fig. 9. These parts represent castings and forgings that are of a nature similar to the work found in the average production shop.

The wise designer makes any given unit serve on as many sizes of machines as possible. But he doesn't make the mistake of designing it for a small machine and then using it on the larger sizes. He designs it for the heaviest duty and knows that it has plenty of strength for any service.

Limits of Accuracy in Repetition Work

By H. Applegard
Halifax, England

THE fixing of limits of accuracy upon parts to be manufactured in quantity is arbitrary, and the limits given on the numerous blueprints that have come under the writer's notice vary considerably according to the draftsman's idea of accuracy or the purpose for which the parts are required.

Before fixing limits, it is desirable to know something of the type of machine upon which the work will ultimately be produced—whether single-spindle or multiple-spindle automatic machine, or ordinary lathe.

Broadly speaking, the lathe is the best type of machine for working to fine limits in the machining operation, but whether or not the work should be produced in the lathe, will depend to a large extent upon the size and the quantity needed. The single-spindle machine will produce more accurate work than the multiple spindle, conditions being equal.

It should be borne in mind that limits fixed on the small side will have the greatest effect upon the price, both because of the facts that closer attention must be given to the work and that there will be a larger percentage of rejects.

The conclusion to be drawn is, that limits placed on the blueprint should be capable of being maintained on the machines upon which the parts will be produced, but not be fixed so fine as to need constant attention and resetting of tools, since this is bound to increase the cost of the parts. It is important, however, that limits should be stated if interchangeability of parts—made, possibly, by different firms—is to be obtained. Particularly is this the case with manufacturers of motor cars.

For the first case, let us take the turning of metals upon the automatic machine. The limits stated in Table I will give a sufficient margin of accuracy to cover most requirements. These limits are capable of being maintained, providing both roughing and finishing tools are employed and the material is free cutting. It will be noticed that the limits are widened proportionately in the case of high-carbon steel.

When a special kind of fit is needed that makes it important to maintain especially close limits of accuracy, the external diameter should be ground. The blueprint should state clearly the kind of fit that is desired and the small standard of limits should be followed.

As diameters, when turned, are invariably required to enter drilled holes it will be noted that but a slight plus limit is possible. It is useful to remember that rods of free-cutting steel are correct to a limit of

Table I—Diameter

	¼	5/16	⅜	7/16	½	⅝	¾	⅞	1
Mild steel	+0.0005 −0.0015	+0.0005 −0.0015	+0.001 −0.0015	+0.001 −0.002	+0.001 −0.002	+0.001 −0.002	+0.001 −0.0025	+0.001 −0.0025	+0.001 −0.003
High-Carbon Steel	+0.0005 −0.0025	+0.001 −0.003	+0.001 −0.003	+0.001 −0.004	+0.001 −0.004	+0.001 −0.004	+0.001 −0.004	+0.001 −0.005	+0.001 −0.005
Brass	+0.0005 −0.001	+0.0005 −0.001	+0.0005 −0.001	+0.0005 −0.0015	+0.0005 −0.0015	+0.0005 −0.0015	+0.001 −0.002	+0.001 −0.002	+0.001 −0.002

Table II—Threads (Whitworth)

Whitworth Size	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
Full Diameter	—0.0018	—0.002	—0.0021	—0.0023	—0.0025	—0.0028	—0.003	—0.0033	—0.0035
Effective Diameter	—0.0018	—0.0021	—0.0024	—0.0027	—0.003	—0.0035	—0.004	—0.0045	—0.005
Core Diameter	—0.0023	—0.0025	—0.0028	—0.003	—0.0032	—0.0039	—0.0039	—0.0041	—0.0045

Table III—Drilled Holes

Diameter of Hole	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
Mild Steel	+0.0025	+0.0025	+0.003	+0.003	+0.0035	+0.0035	+0.004	+0.005	+0.005
Hard Steel and Phosphor Bronze	+0.0035	+0.0035	+0.004	+0.004	+0.0045	+0.005	+0.005	+0.006	+0.006
Brass	+0.0015	+0.0015	+0.002	+0.002	+0.002	+0.0025	+0.0025	+0.003	+0.0035
Cast Iron	+0.004	+0.004	+0.004	+0.005	+0.005	+0.006	+0.006	+0.007	+0.008

Table IV—Overall Length

Length	±1/4 to 1/2	±9/16 to 1	±1 1/16 to 1 1/2	±1 9/16 to 2 1/2
Mild Steel	±0.005 to 0.007	±0.007 to 0.010	±0.010 to 0.012	±0.012 to 0.015
Brass	±0.003 to 0.005	±0.005 to 0.007	±0.007 to 0.010	±0.010 to 0.012

—0.002 in.; extruded brass to ±0.003 in. up to 1/2, and ±0.004 up to 1 in.; rolled brass to +0.010 in., and drawn brass from —0.001 to —0.003 in. for rods up to 1 in. in diameter.

In fixing limits upon work to be threaded, one should be guided by the excellent reports submitted by the Engineering Standards Committee upon British Association and Whitworth threads. Judging from my experience with a large number of prints, it is evident to me that there are many draftsmen who are either not aware of these reports or else have no copy of them.

In practice, the variation in full effective diameter depends to some extent upon the variations in the turning operation, but it also depends upon the sharpness of the threading die. As a die becomes more blunt, the squeezing action increases, and when it is carried beyond a certain point, not only are the tops of the threads rough and unsightly, but the size is affected. With ordinary care, a skilled operator can, if his machine is in a good state of repair, produce quantities of threaded parts to the limits as given in Table II, by the Engineering Standards Committee.

It is surprising to note that, in spite of the fact that the effective diameter is the most important, in the majority of cases where limits are stated, it is the outside diameter that is used as the basic measurement. This is probably due to the fact that in the majority of workshops, the micrometer, along with the ring gage, is used more than any other type of instrument to measure screw threads.

The advantage to be gained by specifying limits on the full diameter of a thread is not great, since the fit of a screw in a standard gage depends more upon the effective diameter and the pitch of the thread. A better method is to specify the fit required in a standard gage—whether easy, tight or good fit—and teach the supplier to make the parts accordingly.

Until the majority of firms are equipped to gage screw threads correctly, the limits on outside diameter are useful only when accompanied by a specification of the kind of fit desired. To this end Table II can be used with a reasonable degree of safety when good fits are necessary.

When the parts are to be used in connection with holes that have already been tapped, it is good practice to send a fitting with the order, or, if the fitting is too bulky, to send a piece of metal that has been threaded with the same tap. This will insure interchangeability of parts, and is especially useful when the threads are to no recognized standard.

Before fixing limits for drilling, it is necessary to know what allowances are usually required by the makers of twist drills. Drills from the best makers can, however, be relied upon to be correct within a limit of ±0.001 in. up to 1/2 in. and ±0.0015 in. up to 1 in. in diameter. All twist drills have a backward taper of approximately 0.001 in. per inch of length, and this factor, in conjunction with the normal wear upon the lands, can be set against the slight variation in size of drills, which are usually ground after they are hardened.

Table V—Depth of Head

Depth	1/4	5/16	3/8	7/16	1/2
Mild Steel	±0.003	±0.004	±0.004	±0.005	±0.005
Brass	±0.002	±0.003	±0.003	±0.004	±0.004

Table VI—Diameter and Width of Form

Size	1/4 x 1/4	5/16 x 5/16	3/4 x 3/4	1/2 x 1
Mild Steel	+0.002 —0.005	+0.002 —0.007	+0.002 —0.010	+0.003 —0.012
Brass	+0.001 —0.004	+0.001 —0.005	+0.001 —0.007	+0.002 —0.010

If you take a profit out of your own business, consider first your own business as a place to invest it. If you have made a success in your present capacity the chances are you will be able to increase your profits by investing your earnings back in your own business.

The bath tub and the flivver are symbolic of the American workman's superiority.

The Design of Gear Tooth Forms

By Earle Buckingham
Associate Professor of Engineering Standards and Measurements
Massachusetts Institute of Technology

Characteristics of the cycloid, epicycloid and hypocycloid curves—Their application to tooth forms and the resulting lines of action—Cycloidal blower rotors

THE PATH described by a point on the circumference of a circle which rolls upon a straight line, is called a *cycloid*. When the point where the curve meets the straight line is the origin, the equation of this curve and its derivation is as follows:

Referring to Fig. 10, let

a = radius of rolling circle

ψ = angle of rotation of rolling circle.

The distance from the origin to the point of contact of the rolling circle with the straight line is equal to the length of the arc ψ at radius a, which equals $a\psi$. The generating point on the rolling circle is at a distance of $a \sin \psi$ from the vertical centerline of the rolling circle, whence,

$$x = a\ (\psi - \sin \psi) \qquad (1)$$

The generating point on the rolling circle is at a distance of $a \cos \psi$ below the center of this circle, whence,

$$y = a\ (1 - \cos \psi) \qquad (2)$$

These two equations are the simplest form in which the equation of a cycloid can be given. They can be

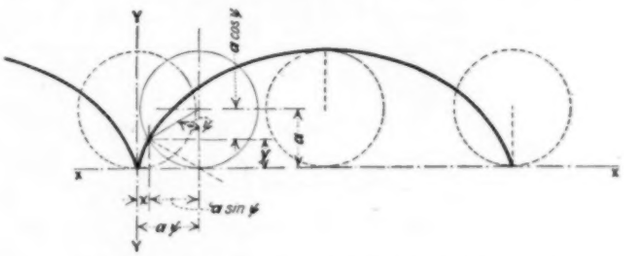


Fig. 10—Development of the cycloid curve

combined into a single equation, and the third variable ψ can be eliminated as follows:

Transposing equation (2), we have

$$\cos \psi = \frac{a - y}{a}$$

$$\sin \psi = \sqrt{1 - \cos^2 \psi} = \frac{\sqrt{2ay - y^2}}{a}$$

$$\psi = \cos^{-1}\left(\frac{a - y}{a}\right)$$

Substituting in equation (1), we have

$$x = a \cos^{-1}\left(\frac{a - y}{a}\right) - \sqrt{2ay - y^2} \qquad (3)$$

In general, equations (1) and (2) will be found more convenient than equation (3). From equations (1) and (2) we derive the equation for the tangent as follows:

$$\tan \phi = \frac{dy}{dx} = \frac{\sin \psi\, d\psi}{(1 - \cos \psi)\, d\psi} = \frac{\sin \psi}{1 - \cos \psi} \qquad (4)$$

where ϕ is the angle that the tangent makes with the X-axis.

The Epicycloid

When a circle, tangent to a fixed circle externally, rolls upon it, the path described by a point on the circumference of the rolling circle is called an *epicycloid*. Taking the origin at the center of the fixed circle, and the Y-axis passing through the point where the curve meets the fixed circle, we derive its equation as follows:

Referring to Fig. 11,

Let a = radius of fixed circle

b = radius of rolling circle

ψ = angular movement of rolling circle on fixed circle

β = angle of rotation of rolling circle.

The length of the arc on the fixed circle from the point of contact between the two circles and the Y-axis is equal to $a\ \psi$. This arc is equal to the length of the arc on the rolling circle from the generating point to the point of contact between the two circles, which in turn is equal to $b\ \beta$, whence,

$$a\ \psi = b\ \beta \qquad \beta = \frac{a}{b}\ \psi$$

From Fig. 11 we get

$$x = (a + b) \sin \psi - b \sin (\psi + \beta) =$$

$$(a + b) \sin \psi - b \sin \left(\frac{a + b}{b}\right) \psi \qquad (5)$$

$$y = (a + b) \cos \psi - b \cos (\psi + \beta) =$$

$$(a + b) \cos \psi - b \cos \left(\frac{a + b}{b}\right) \psi \qquad (6)$$

These two equations are the simplest form in which the equation of the epicycloid can be given. They can

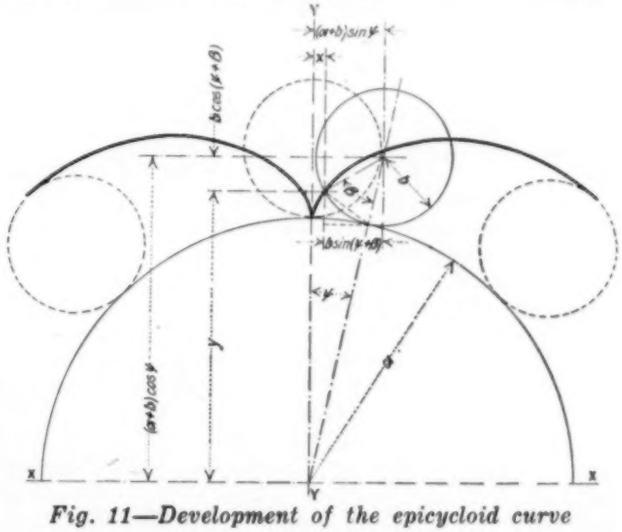


Fig. 11—Development of the epicycloid curve

The third article. The fourth will appear in an early issue.

be combined and the third variable ψ eliminated, but this combined form would be too complex to serve any useful purpose here.

From equations (5) and (6) we derive the equation for the tangent as follows:

$$\tan \phi = \frac{dy}{dx} = \frac{(a+b)\left[\sin\left(\frac{a+b}{b}\right)\psi - \sin\psi\right] d\psi}{(a+b)\left[\cos\psi - \cos\left(\frac{a+b}{b}\right)\psi\right] d\psi} = \frac{\sin\left(\frac{a+b}{b}\right)\psi - \sin\psi}{\cos\psi - \cos\left(\frac{a+b}{b}\right)\psi} \quad (7)$$

where ϕ is the angle that the tangent makes with the X-axis.

The Hypocycloid

When a circle, tangent to a fixed circle internally, rolls upon it, the path described by a point on the circumference of the rolling circle is called a *hypocycloid*. Taking the origin at the center of the fixed circle, and the Y-axis passing through the point where the curve meets the fixed circle, we derive its equation as follows:

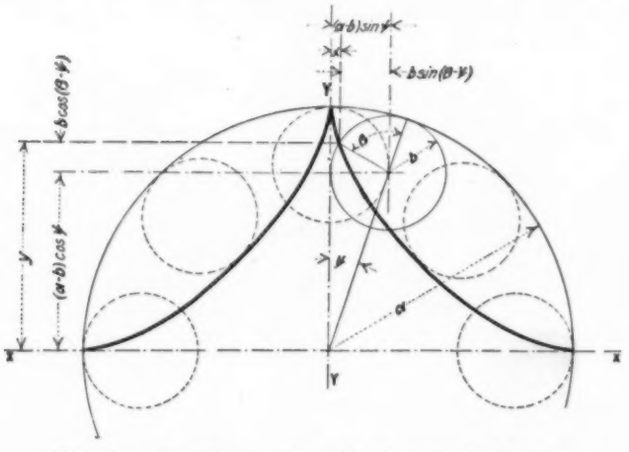


Fig. 12—Development of the hypocycloid curve

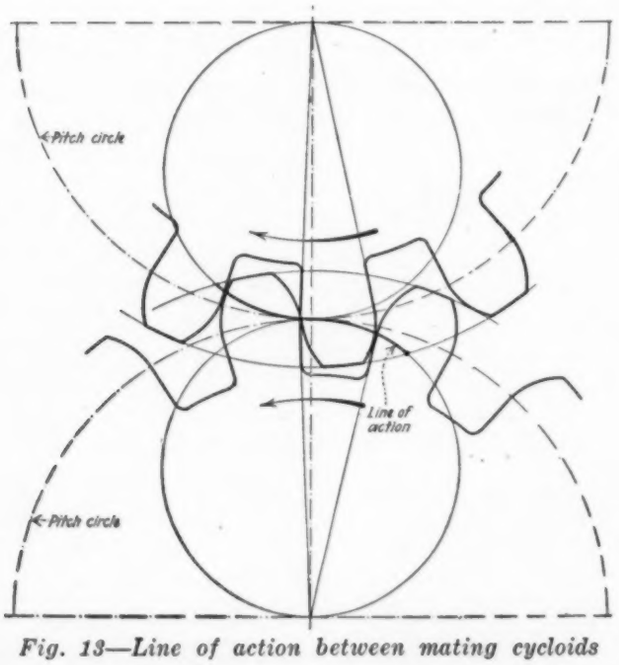


Fig. 13—Line of action between mating cycloids

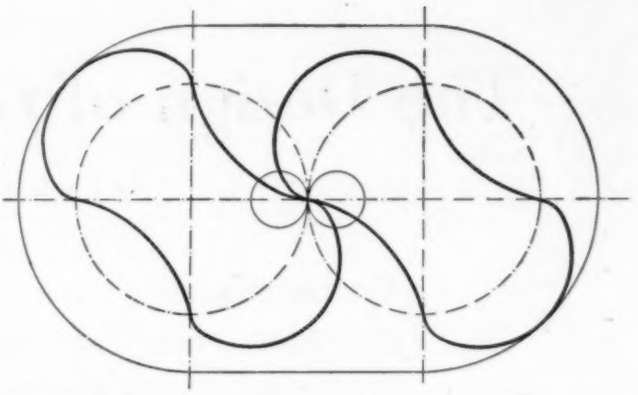


Fig. 14—Blower with a pair of two-lobed rotors of full cycloidal form

Referring to Fig. 12

Let a = radius of fixed circle

b = radius of rolling circle

ψ = angular movement of rolling circle on fixed circle.

β = angle of rotation of rolling circle.

$$a\psi = b\beta \qquad \beta = \frac{a}{b}\psi$$

from Fig. 12 we get

$$x = (a-b)\sin\psi - b\sin(\beta-\psi) = (a-b)\sin\psi - b\sin\left(\frac{a-b}{b}\right)\psi \quad (8)$$

$$y = (a-b)\cos\psi + b\cos(\beta-\psi) = (a-b)\cos\psi + b\cos\left(\frac{a-b}{b}\right)\psi \quad (9)$$

These two equations are the simplest form in which the equation of a hypocycloid can be given. From them we get for the tangent,

$$\tan \phi = \frac{dy}{dx} = \frac{(a-b)\left[\sin\left(\frac{(a-b)}{b}\right)\psi - \sin\psi\right] d\psi}{(a-b)\left[\cos\psi - \cos\left(\frac{a-b}{b}\right)\psi\right] d\psi} = \frac{\sin\left(\frac{a-b}{b}\right)\psi - \sin\psi}{\cos\psi - \cos\left(\frac{a-b}{b}\right)\psi} \quad (10)$$

where ϕ is the angle that the tangent makes with the X-axis.

Line of Action

The normals to the cycloidal profiles are perpendicular to the tangents. In Fig. 10 a dotted line is shown from the generating point to the point of contact of the rolling circle with the straight line. The lengths of the legs of the right triangle of which this dotted line is the hypotenuse are, respectively,

$$a\sin\psi \text{ and } a(1-\cos\psi)$$

The value of the cotangent of the angle between this dotted line and the X-axis is

$$\frac{a\sin\psi}{a(1-\cos\psi)} = \frac{\sin\psi}{1-\cos\psi}$$

A comparison of this equation with the one for the tangent of the cycloid, equation (4), shows equal values. This dotted line is therefore perpendicular to the tangent. In other words, this dotted line is the normal to the cycloid. Thus, the normal to the cycloid passes through the generating point and the point of contact of the rolling circle with the straight line upon which it rolls.

In Fig. 11 a dotted line is shown between the generating point and the point of contact between the fixed and the rolling circles. Another dotted line is shown from this point of contact parallel to the X-axis. The lengths of the legs of the right triangle thus formed are, respectively,

$$b\left[\cos\psi - \cos\left(\frac{a+b}{b}\right)\psi\right]$$

and $$b\left[\sin\left(\frac{a+b}{b}\right)\psi - \sin\psi\right]$$

The value of the cotangent of the angle included between the two dotted lines is

$$\frac{b\left[\sin\left(\frac{a+b}{b}\right)\psi - \sin\psi\right]}{b\left[\cos\psi - \cos\left(\frac{a+b}{b}\right)\psi\right]} = \frac{\sin\left(\frac{a+b}{b}\right)\psi - \sin\psi}{\cos\psi - \cos\left(\frac{a+b}{b}\psi\right)} \quad (11)$$

A comparison of this value with the equation for the tangent of the epicycloid, equation (7), will show that they are identical. *The normal to the epicycloid, therefore, passes through the generating point and the point of contact of the fixed and rolling circles.*

In like manner it will be found that the normal to the hypocycloid also passes through the generating point and point of contact of the fixed and rolling circles.

Application to Tooth Forms

This point of contact of the rolling circle with the line upon which it rolls represents the pitch point when

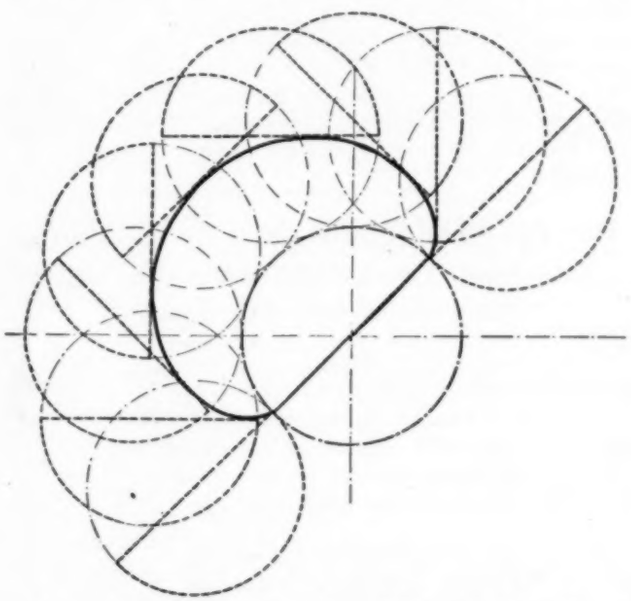


Fig. 15—Straight-line hypocycloid generating the corresponding epicycloid

these curves are used as gear tooth profiles. The generating point represents a point of contact between mating cycloidal curves. In all cases of mating cycloids, the size of the rolling circles must be identical. The line of action between such forms is, therefore, the outline of the rolling circles, as shown in Fig. 13, and the fixed circles or the straight line upon which the rolling circles roll to generate the cycloidal forms become the pitch circles or the pitch line of the gears or racks respectively.

When the size of the rolling circle is made one half the size of the fixed circle, the equation of the hypocycloid becomes as follows:

$$a = 2b$$

Equation (8) becomes

$$x = \frac{a}{2}(\sin\psi - \sin\psi) = 0$$

Equation (9) becomes

$$y = \frac{a}{2}(\cos\psi + \cos\psi) = a\cos\psi$$

The shape of this cycloid is a radial line along the Y-axis. Thus, to design a gear form with radial flanks below the pitch circle, the diameter of the rolling circle is made one half the diameter of the pitch circle.

Design of Cycloidal Rotors for Blowers

The cycloidal form is extremely well adapted for use in blowers and is widely used in those known as the Root type. As a matter of fact it would also be a more

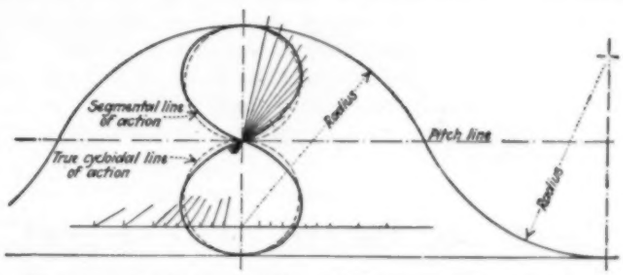


Fig. 16—Rack-type cutter with circular arc profiles

efficient form than the involute now used in oil and water pumps, but it would require a more elaborate construction to realize this improved efficiency. The action between the two rotors is conjugate gear tooth action, but the pressure angle between them rises so high that one will not drive the other through the whole cycle so that other gears must be used to drive them.

In Fig. 14 is shown a pair of two-lobed rotors of full cycloidal form. In this case the diameter of the rolling circle is one quarter the size of the fixed or pitch circle. If three lobes were desired, the diameter of the rolling circle would be one sixth the diameter of the pitch circle.

One of the disadvantages of the cycloidal form is the practical difficulty of producing it. If the rotors are small enough to be generated on a gear shaper with a pinion-shaped generating tool, the form of such a tool can be readily generated by taking advantage of the fact that when the size of the rolling circle is one half that of the pitch circle, the form of the resulting hypocycloid is a straight line.

As an example, we will assume that the pitch circle of the rotors shown in Fig. 14 is four inches in diameter. The diameter of the rolling circle is one quarter of this, or one inch. By making a cutter two inches in diameter, of semicircular form, we can generate the corresponding epicycloid on a similar blank, as indicated in Fig. 15. This epicycloid, together with the straight line through the center, gives us the complete form of a one-lobed cutter which would generate the desired form on the rotors. This method was originated by Paul M. Mueller of Pratt & Whitney Co.

This form of cutter, however, would be impractical if the rotors were of any appreciable length, as the form extends through the center of the cutter, and the present design of such gear-generating machines does not permit the excessive height above the work table that

would be necessary. A template could be produced, however, from which form-milling cutters could be made, or which could be used as a template for shaping, or which would represent the form of a two-lobe pinion type cutter. This last could be used directly on the gear shaper, as long as the length of the rotors is not greater than the maximum face of gear which the machine can produce.

For generating machines that use a cutter of basic rack form, the segmental form is a more practical and better tooth form to use than the cycloidal. This form is a close approximation to the cycloid, and is composed of arcs of circles, whose centers are off of the pitch line, as shown in Fig. 16. The action between rotors generated from such a basic rack would be theoretically correct. The line of action, instead of being two perfect circles, is straightened out near the pitch line, and flattened off at the top and bottom of the two lobes. This is also shown in Fig. 16. As this form is composed of arcs of circles, templates or form tools can be very accurately made on master plates, if desired. Due to the fact that its basic rack form can be more accurately reproduced than the cycloid can be, the segmental form may be used to advantage in many cases in place of the cycloid.

Seen and Heard—Discussion

BY HARRY SENIOR

Being afflicted with toothache this afternoon I feel just like kicking somebody, and the kickingest person in sight seems to be John R. Godfrey, who says in an article under the title given above, on page 575, Vol. 63, of the *American Machinist*, that the proper shape of tool to take a lot of stock off a piece of work in a lathe is the old-fashioned side tool with which we old gray-whiskered guys used to square up the ends of a bar, or face down the side of a piece in the chuck.

I do not know much about the Klopstock form of cutting tool, I am not sure that I remember as much as I ought about the way Mr. DeLeeuw's cutting tool worked, and all that I can tell anybody about a "circular tool that rolls into the work" is that it works fine in spalling off granite from a round column, but I have used diamond points, "round noses" and side tools all my life.

One thing that I know about the diamond point is that it is not—Fred Taylor to the contrary notwithstanding—a back number. If I had a dollar for every one of them that is in use right this minute, I would invite Mr. Godfrey to take a trip around the world with me in the steam yacht I would buy with the money.

Forged tools of all shapes got a serious set-back (not a knockout) when the high-speed toolbit and its convenient holder became available, but that was not because of the shape of the cutting edge, it was because of the lessened cost. The rear end of a forged tool costs just as much as the business end, and while it is holding up the latter it is doing nothing else, whether it is at work in the lathe or merely lying idle on the tool board. A stock of tools forged from material that costs anywhere from twenty cents to a dollar or more a pound, can tie up a lot of capital.

When the Armstrong type of holder came on the market, and the old man could buy fifty tools (bits) for the previous cost of one, he was not disposed to be hypercritical if the newly acquired brother did not do quite so much or so good work as the old stand-by, or perhaps just as much work but with increased consumption of power. Power was the least of the old man's troubles; it was the vacuum in the place where his bank balance ought to be that kept him awake nights.

What I want to quarrel with Mr. Godfrey about, is his application of the term "side tool" (or diamond point for that matter) to a chunk of steel that is big enough and stocky enough to hog the stock off a bar or casting to the limit of the lathe's ability to pull the cut. It is the *edge* of a tool that cuts ice (metal, I mean), and if that edge is rigidly supported at the proper angles of rake and clearance with relation to the material to be cut off, what has the shape of the supporting portion got to do with it?

Why has it got to be a "side tool," or a "diamond point"? Why cannot an apprentice boy grind an edge on the butt end of a bar of stock, harden and temper it, and cut off just as much stock per minute with it as if it had been made by Fred Taylor and christened with a fancy name?

And in case anybody comes along to tell me that what I need to cut off stock with, is a "round-nose," or something with an ogee curve in it, I want to tell him right now that it isn't so. Just as a straight line is the shortest distance between two points, so is a straight line the best possible disposition of metal to form a sturdy cutting edge.

The amount of material cut off per revolution in a lathe is, for a given depth of cut, the product of the circumference of the work and the rate of feed per revolution, and of nothing else. By using a round-nosed tool and making a chip that is shaped like half of a new moon, the actual thickness of the chip is decreased, but its length is correspondingly increased, and the total pressure of the cut is also increased.

Buy for Production—Sell by the Pound

BY LORING ROPER

Here's another sign of progress
'Mongst the users of machines.
They are throwing out the old ones,
And are digging in their jeans
For the cash to buy some new ones
That will help their output grow,
They are selling off the old stuff
When it gets too old to go.

I've a list of tools before me
From a ship plant by the sea,
And the names of tools so listed
Sounds like ancient history.
Lathes and planers, long departed
From the memory of men,
Are at last thrown out of service,
Offered up for sale again.

There's a postscript that, however,
Tells us that they know they're old,
If as tools we cannot use 'em
By the pound they will be sold.
So, although they're late discarding,
We rejoice at last they've found
They should "buy tools for production
And then sell them by the pound."

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Rods for Rickenbacker Engines

By Fred H. Colvin
Editor, *American Machinist*

How connecting rods are made for both the 6- and 8-cylinder engine — Grinding the small hole — Broaching the shaft end to suit crankpin

SOME of the methods used in making the Rickenbacker connecting rods are of special interest, both as to the fixtures used and the way in which standard machines are utilized. The use of the same rod for both the 6-in. and the 8-cylinder engine, add to the quantity required and makes the production problem easier. It also reflects credit on the engineering department and is a practice that may well be considered where more than one type of engine is built. One advantage of this method is lower production costs.

The first operation is to inspect the forging and straighten it if necessary, using alignment gages. The sides are then milled at both ends on a Briggs milling machine using the indexing fixture shown in Fig. 1. The rods are held in reverse order so that one pass mills a large and a small end at the same time. By indexing the fixture the opposite ends are milled at the next pass. The rods are held without previously spotting one or more locating spots, the pin *A* locating the binding lug for the piston pin and the jaws *B* positioning the rod by the bolt bosses. The upper jaws are of the equalizing type and hold the rods firmly at each end.

The binding-screw hole is next drilled and spotfaced, after which the piston-pin hole is drilled and reamed to 0.983-0.985 in. and the large hole drilled to 2⅞ in., as in Fig. 2, the machine used being a 6-spindle Foote - Burt. The rods rest on the milled side surface; the large ends of the rods fit into centering jaws and the binder screw holes are used to locate the small ends. Screw-operated jaws clamp the small ends.

The large holes are reamed to 2.249-2.251 in., and both holes are chamfered on the Colburn 2-spindle machine, Fig. 3. The reaming is done at the right, with the rod located by a pin in the small end and clamped at the large end. The chamfering is done under the left spindle, the large-end tool being shown in position. The small-end tool is mounted below the tool for the large end on the same arbor.

Locating surfaces *A* are now milled on each of the bolt bosses, as in Fig. 4, the block *B* being used as a gage for setting the cutters.

Anchor grooves for the babbitt bearing are then cut on a No. 3 La Pointe broaching machine, Fig. 5, the broach carrying four strips of cutting teeth, making two grooves in both the rod and the cap. Three rods are broached at once. Babbitting is done by the centrifugal method, insuring a dense bearing metal and having the further advantage of eliminating any dirt or impurities. Since the impurities are lighter than the babbitt, they stay near the center and are removed by the boring tool.

An indexing fixture is used in a Natco machine for drilling the bolt holes, five rods being drilled at once, as in Fig. 6. The swinging clamps make it easy to move and replace the work. The bushing plate acts as a reservoir and carries an ample supply of lubricant to the drills. Reaming the holes follows, after which the

Operations

Inspect and count	Ream two bolt holes
Heat-treat	Saw apart and mill bolt seats
Snag	Drill ⅛-in. oil hole in large end
Spot for Brinell test	Countersink bolt holes in rod
Brinell test for hardness	Counterbore holes in caps
Rough grind flash	File joint surfaces
Straighten	Assemble rods and caps
Straddle mill both sides of bosses	Mill outside, large end
Drill and spotface binder hole	Bore, face and chamfer both sides of babbitted hole
Drill and ream small hole	Burr
Ream large hole	Broach hole
Chamfer both sides of large boss and wrist-pin hole	Burr small hole
Straddle mill locating lugs	Straighten
Broach anchor grooves	Grind hole in small end
Babbitt	Mill binder slot
File off excess babbitt	Tap binder hole
Rough drill babbitt hole	Burr and chamfer oil hole
Drill two bolt holes	Wash
100 per cent inspection	

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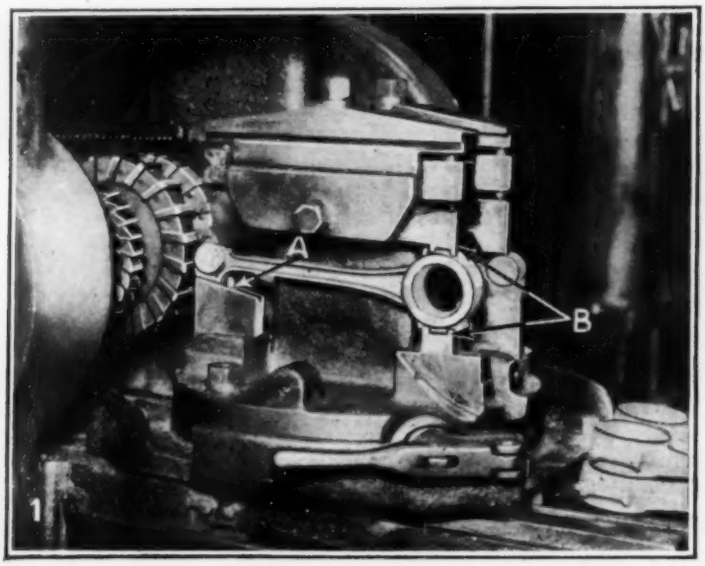

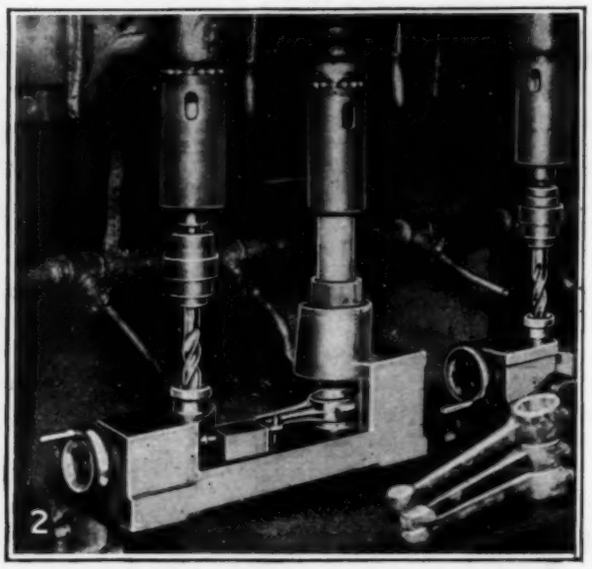

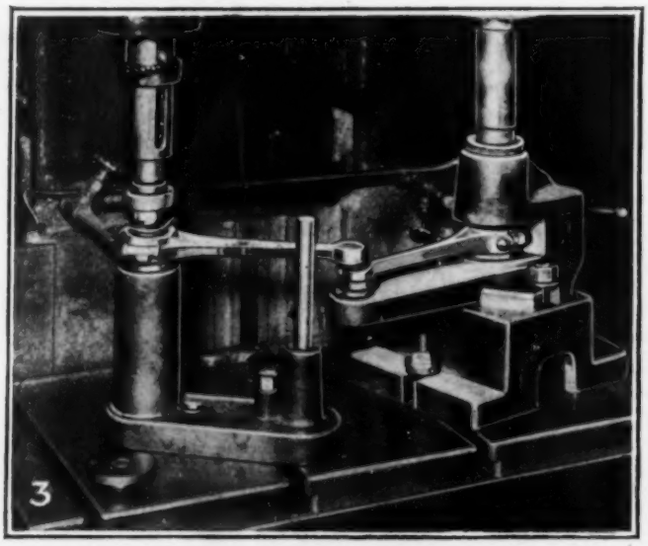

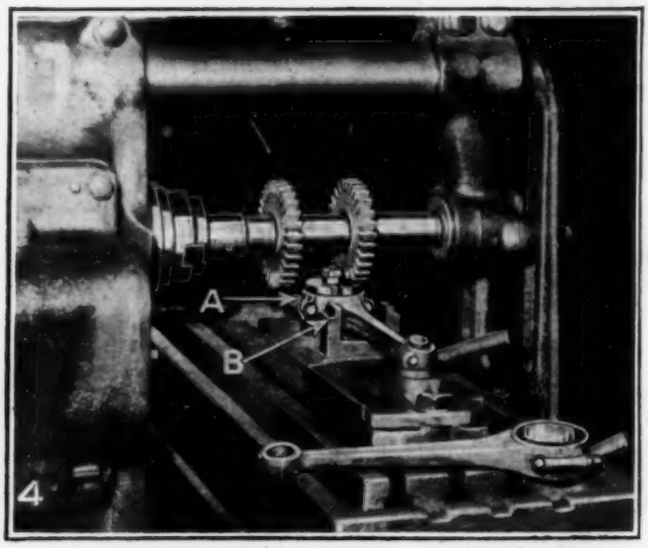

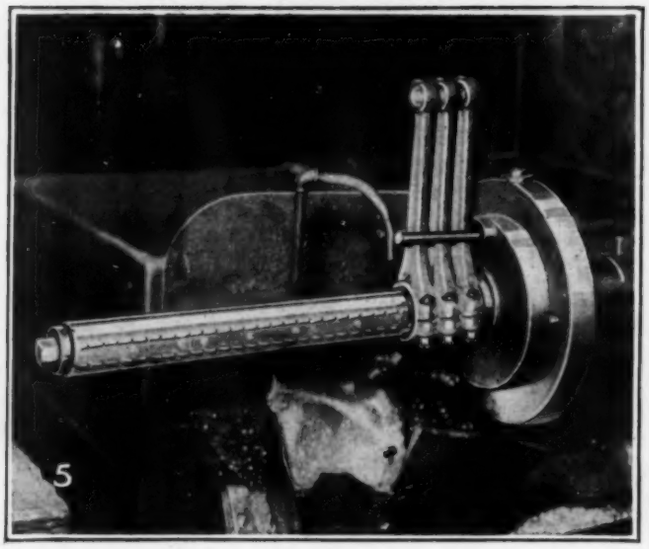

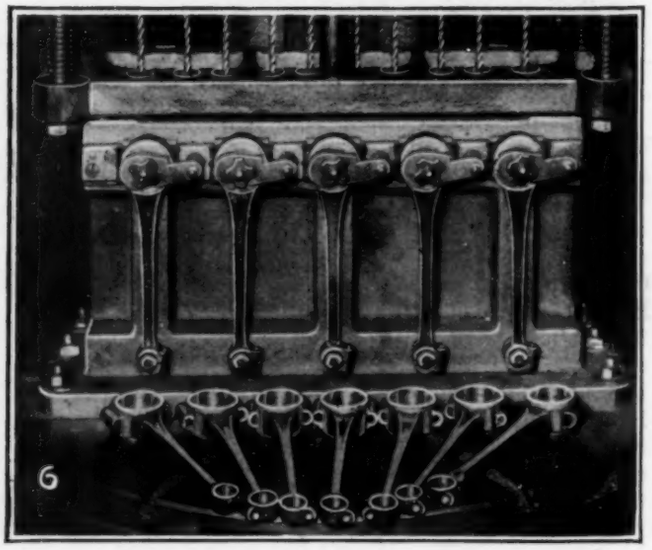

Fig. 1—First machining operation. Fig. 2—Drilling both ends. Fig. 3—Reaming and counterboring Fig. 4—Milling locating spots. Fig. 5—Broaching anchor grooves for the babbitt. Fig. 6—Drilling bolt holes

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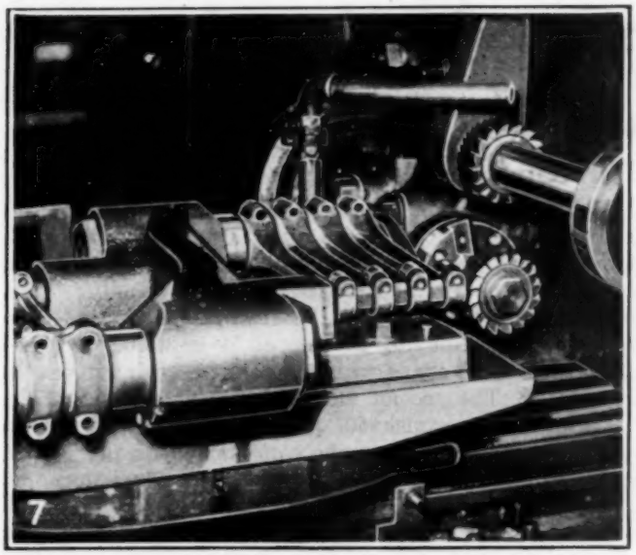

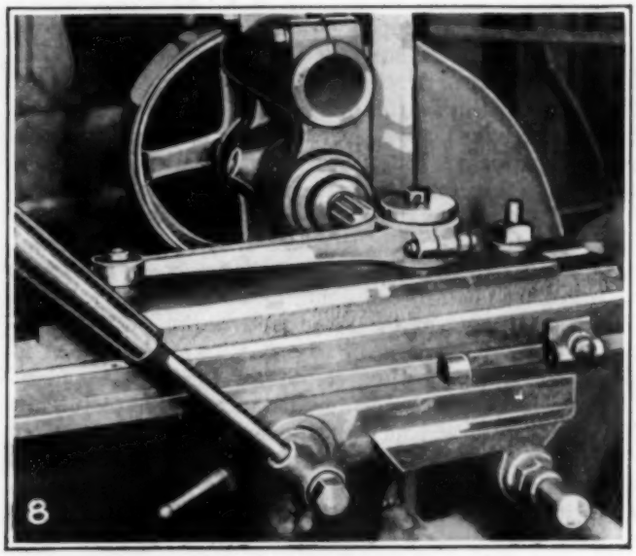

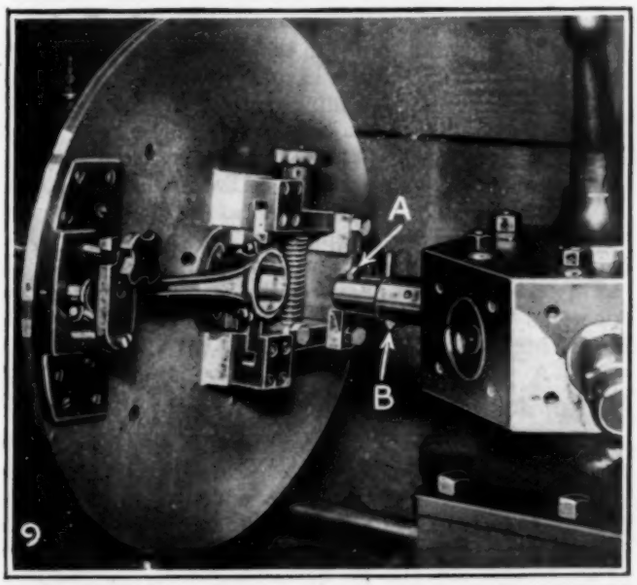

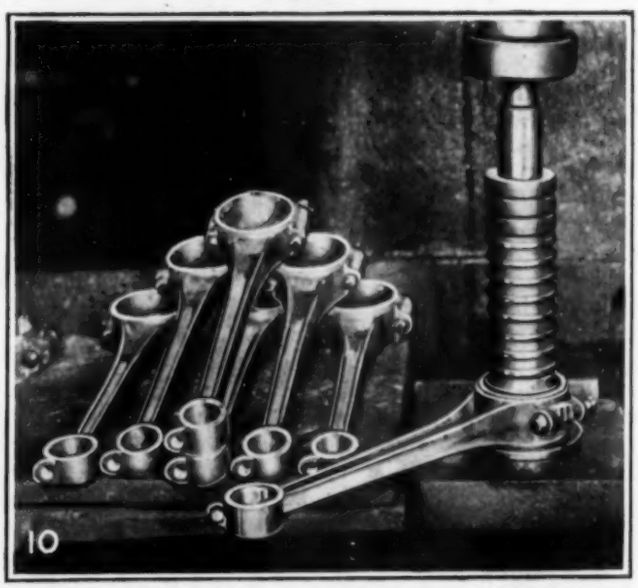

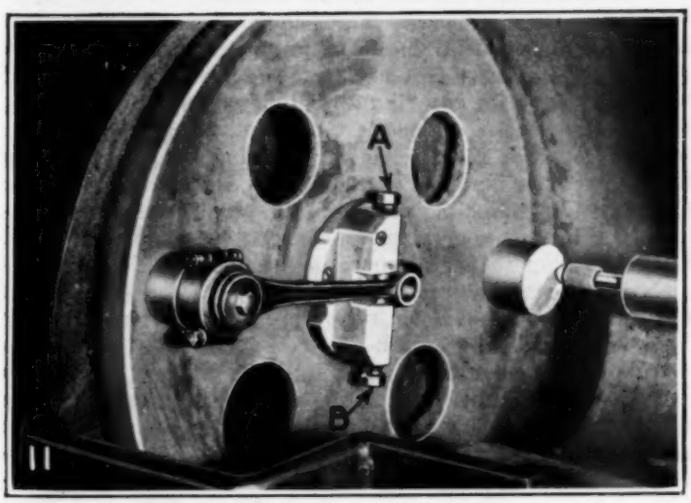

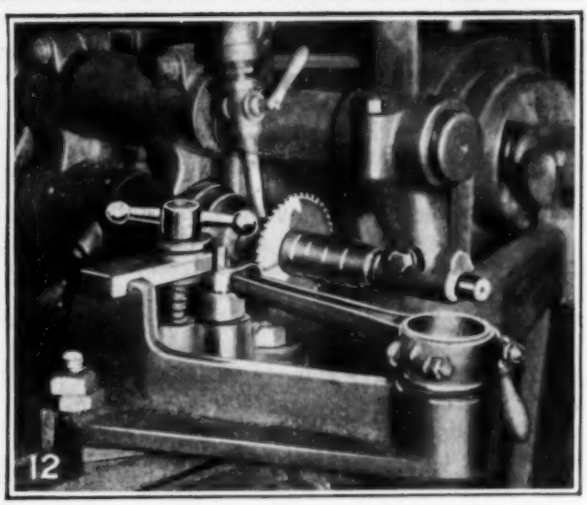

Fig. 7—Sawing off the caps. Fig. 8—Milling the sides. Fig. 9—Boring the babbitt. Fig. 10—Broaching and burnishing. Fig. 11—Grinding piston-pin holes. Fig. 12—Sawing binder slots

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caps are cut off, as in Fig. 7, on a Cincinnati duplex milling machine, equipped with an indexing base fixture.

The fixture holds four rods at each end, locating them by the two bores. Each arbor carries a saw in addition to a side milling cutter. The upper ends of the bolt bosses are faced, and the caps are cut from all the rods at one pass. Indexing the fixture allows reloading while the other four rods are being cut. The bolt holes are countersunk in the rods and counterbored in the caps, and after the joint surfaces are filed, the rods and caps are assembled. Then the bolt bosses on the large ends are trimmed by hand milling as in Fig. 8.

The machining of the large bore begins on the Warner & Swasey machine in Fig. 9, where the babbitt is being bored and the end chamfered by tools *A* and *B*. The rod is located for center distance by the piston-pin hole and held at the other end by a very efficient floating clamp that grips the bolt bosses on each side. The floating jaws grip the bosses and force them back against the fixed jaws on the faceplate. The spring separates the jaws when the pressure is released. The hole is bored to 1.9955-1.9965 in. and then broached to 2.000-2.0005 in. with a push broach, as in Fig. 10. The last three teeth are used for burnishing only.

In reality the bearing holes in the rods are finally broached to suit the pins on which they are to run. It is practically the Martell reamer system applied to broaching rod bearings. Each crankpin is measured and the diameter noted. Then, before the assembling the engine, the proper broach is used to give the desired clearance for the oil film between the pin and the rod. It will be noted that the broach removes from 0.0045 to 0.005 in. This method gives the same results as when the rods are reamed by the selective method.

After straightening the rod, if found necessary, the small hole is ground as in Fig. 11, to insure its being square with the large bore, and to avoid the necessity for any straightening in the assembling department. In fact no straightening or bending is permitted after the piston-pin hole is ground. The rod is held on the counterbalanced faceplate shown, the large end fitting over the outer stud. The small end is held lightly between the two screws *A* and *B* and is not strained sidewise in any way. The grinding operation insures the two bores being parallel, which is an important item in the running of the engine.

The binder slot is then milled on the hand-operated machine shown in Fig. 12, the fixture being so designed as to impose no strains on the rod in mounting or clamping. The small end is rigidly supported against the cut and the clamp designed to allow rapid handling.

Then follows the tapping of the threads in the screw hole, using a ⅜-in. Bay State, 3-fluted, high-speed tap having ground threads. Modern methods of measurements are followed in which the pitch diameter and not the outside diameter is considered. The tolerance is 0.001 in., the pitch diameter being 0.3479-0.3499 in. After burring, a final inspection is made of every rod for alignment, diameter of both bores; of the tapped hole; and of the overall dimension of the large end. The gage for the large bore has diameters of 2.000 and 2.002 in. and the one for the piston-pin hole, 0.999 in. to 1.000 in., while 0.010 in. is allowed on the outside.

Abstracts

from other publications

Hardening Camshafts

Hollow camshafts are quenched and tempered to obtain the desired machinability. One or the other of two methods may be used to obtain a camshaft that can be straightened without breaking after hardening. One consists in copper plating the entire shaft before carburizing and removing the copper by grinding or turning from those areas which are to be carburized and hardened. The second method consists in forging or machining the camshafts somewhat larger, with an excess of metal between the cams and bearings. This excess metal is machined off after carburizing and before hardening. The carburizing operation should be carried out in containers and furnaces of suitable dimensions and design to permit uniform heating throughout the charge.

The time required to attain the depth of case depends upon a number of factors, such as temperature of the furnace at the time of loading, rate of heating, type of furnace, thickness of the containers, amount of stock left for grinding, etc. However, the carburizing time and the amount of stock left before grinding should be so regulated that the depth of case after grinding is at least 0.045 in. The hardness of the camshaft should not be below a scleroscope reading of 75.

This recommended practice has been adopted by the American Society for Steel Treating.—*Automotive Industries*, Jan. 21, p. 111.

Mechanical Pace Making

The automobile industry took the first great stride in the direction of applying mechanical handling systems all the way through the process of manufacture. Manufacturers were literally hurled into such considerations by their problems of mass production and problems of stock carrying and by the necessity for rapid turnover ,since otherwise tremendous capital would have to be invested in unfinished products. Another feature which increased this need was the advent of specialized machinery for speeding up individual operations.

Many miles of the most modern and up-to-date form of conveyor for mechanical handling through the shop have been installed and the overhead conveyor system is solving handling problems in a very satisfactory manner by bringing about a steady flow of product from operation to operation on a mechanical schedule, taking the article up out of the way when it is not needed and bringing it down to the proper operation at steady and regular intervals.

This system avoids accumulation of parts waiting to be worked upon and accumulation of parts which are finished. The speed of this production is in the hands of the management controlling the speed of this overhead conveyor system and not in the hands of the individual operator. Jervos B. Webb, in *Industrial Management*, Feb., 1926, p. 65.

Modern Tooling Methods for Turret Lathes

By M. E. Lange
Production Engineer, The Warner & Swasey Co.

Use of permanent set-up saves time in changing from one job to another—Variety of bushings produced with simple tooling — Drilling cored holes — Overhead-piloted tools

THE improved methods suggested for chucking work, include the use of combined cuts, multiple cuts, and rigid tooling. The equipment described in this article is universal in its application to a wide range of work, so that for the average job production may be increased without changing or substituting individual tools, resulting in greater economy in tool cost.

By arranging the tooling equipment in a permanent set-up, and changing only the forged cutters or bits, the set-up time in changing from one job to another is reduced to a very low figure.

To illustrate the application of better methods, let us first lay out the order of operations for a typical, cast-iron dial, as shown in Fig. 122. The drawing of the piece shows that fairly accurate limits are required. The job is made in small lots on a 16-in. geared, friction-head turret lathe, such as is shown in Fig. 123 in two operations. Since the slide tool is used for part of the facing, the universal-carriage type of turret lathe is not required, so that the machine investment is kept low by using a plain cross-slide type of machine instead.

In chucking work, such a great variety of kinds and types of work is found that considerable thought must often be given to the order of operations, in order to increase production without the use of expensive or special equipment. The aim is to increase the production and at the same time to keep the tool cost and the set-up time as low as possible

The order of operations for the first chucking of this dial is as follows:

1 Rough bore hole and rough turn the outside diameter. At the same time, rough face the rim from the cross-slide.
2. Finish bore and finish turn outside diameter, at the same time, finish facing the rim.
3. Rough and finish face hub.
4. Ream hole.

The layout in Fig. 124 shows the tooling for the first chucking, in which combined cuts are used in operations 1 and 2.

First Operation

The dial is rough turned on the outside diameter, and rough bored with a multiple cutter head, using standard forged cutters, as in Fig. 125. A rocker bushing in the center hole provides quick adjustment for the forged boring cutter. The rim is also rough faced from the cross-slide at the same time, which is not shown in the illustration.

Second Operation

The hole is finish bored, and the outside is also finish turned, using a standard multiple-turning head, as in Fig. 126. At the same time, the outer diameter is faced with the cross-slide, which is not shown in the illustration. Note the positive, micrometer-screw adjustment of the cutter holder itself, and the possibility of performing similar operations on a wide variety of work, by moving the cutter holder quickly to the different holes.

Third Operation

The hub is rough and finish faced with one vertical slide tool, as in Fig. 127. Note the slotted bushing and the graduated dial with clips for the adjustment of the standard, forged cutters. In the fourth operation, which is not shown, the hole is reamed with a standard reamer, held in a floating tool holder.

In the second chucking, Fig. 128, the dial is held with soft jaws on the outside diameter, which was finished in the first chucking. The rim is rough faced from the cross-slide, while the hub is roughed with an ordinary flat cutter held in the vertical-slide toolholder.

Then the outside diameter and the hub are finish faced at the same time with forged cutters held in the one slide tool. The tooling layout is shown in Fig. 129. Since both cuts are taken at the same time with cutters held in the same tool, the close limits of +0.000, —0.001 that are required from inner hub to rim, can readily be duplicated on the entire lot.

The speedometer joint, Fig. 130, is made from a die casting, and presents a problem of interrupted internal cuts. The reamers cannot be floated because of the interrupted cuts where the holes break into each other, as shown in the drawing. Hence, these tools must be perfectly aligned, regardless of inaccuracies of

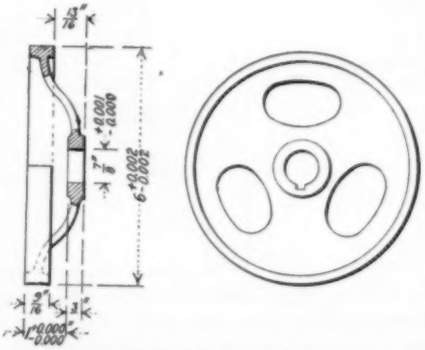
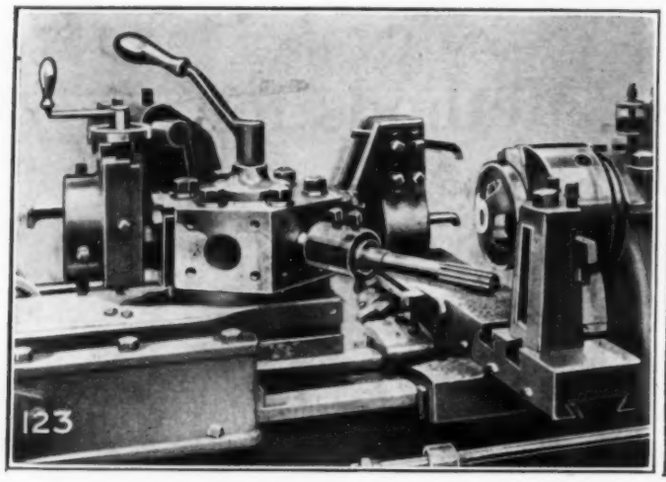
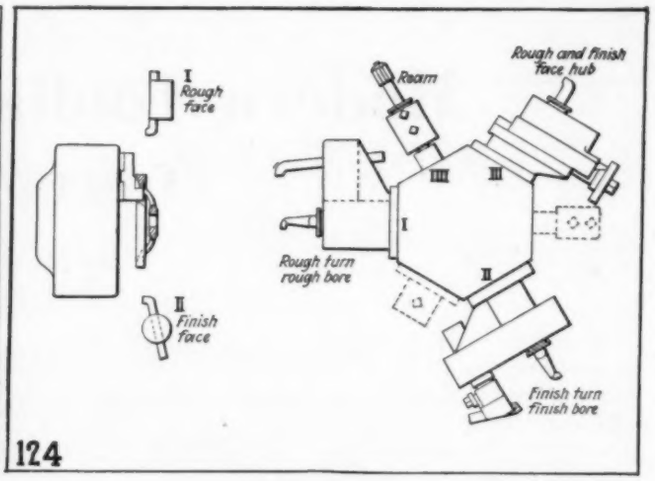
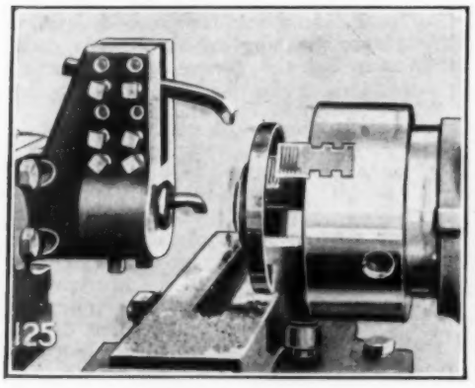


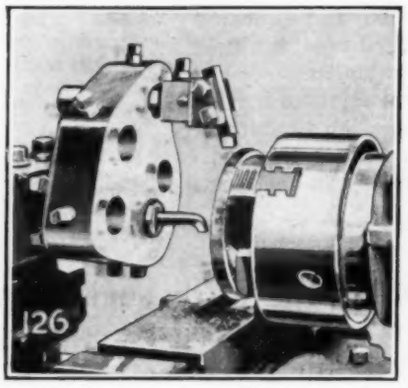
Fig. 122—Typical, cast-iron dial

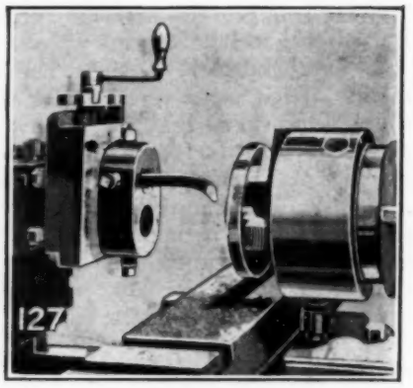
The seventh article. The eighth will appear in an early issue.

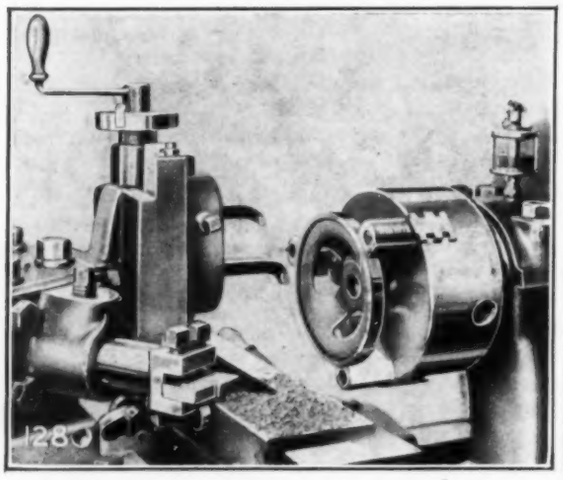


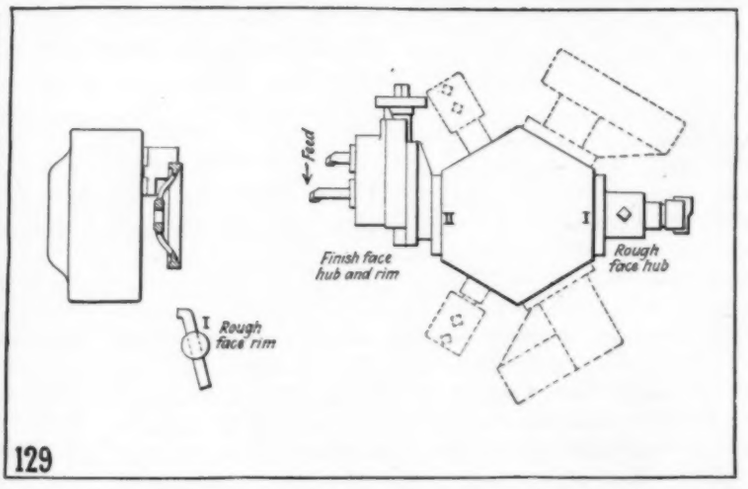


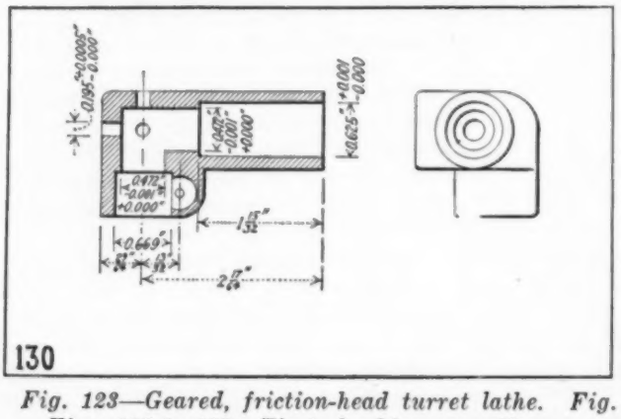












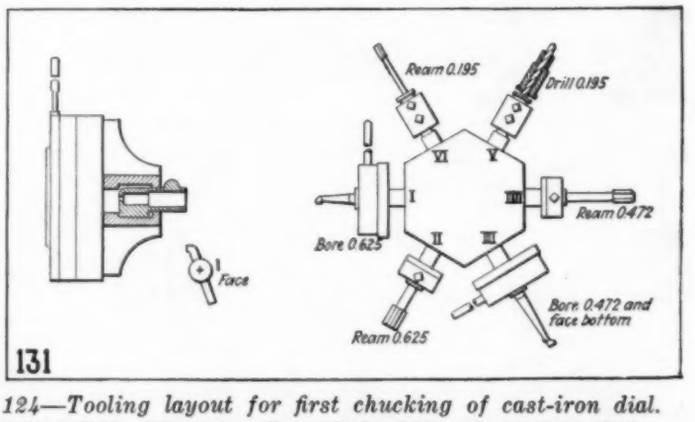
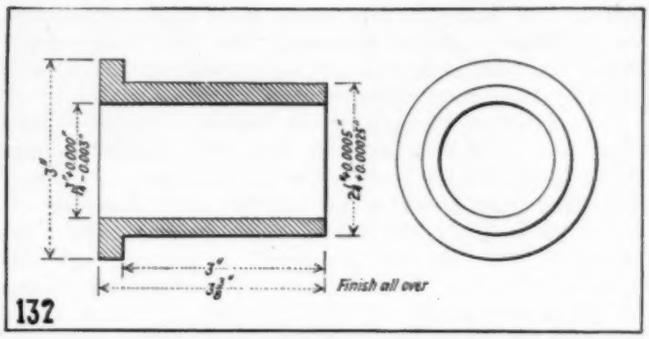
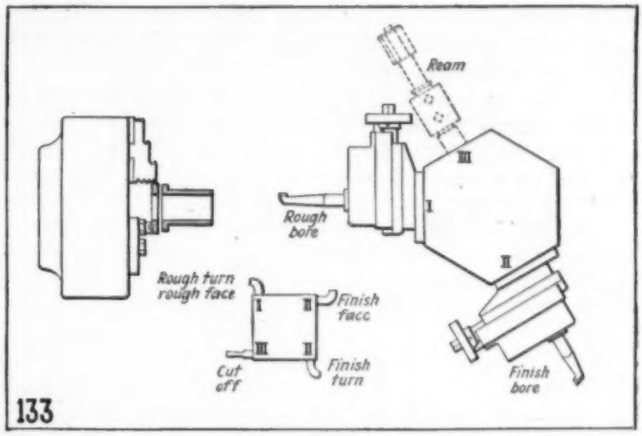
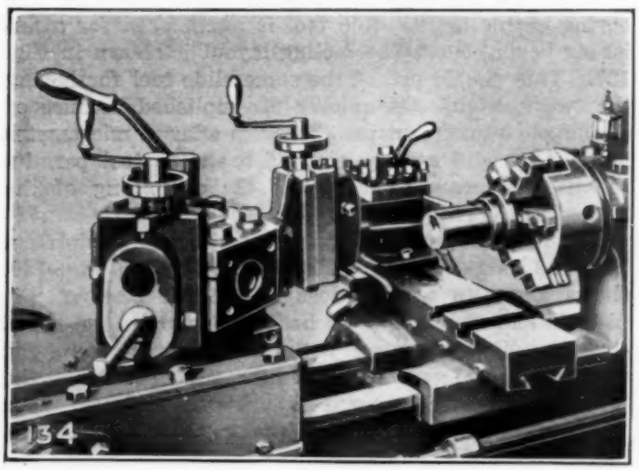
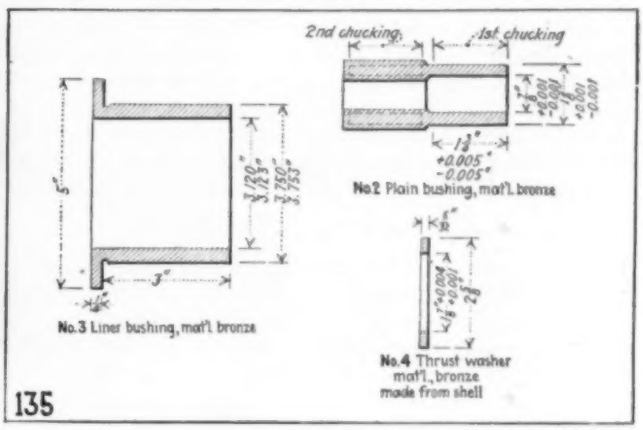


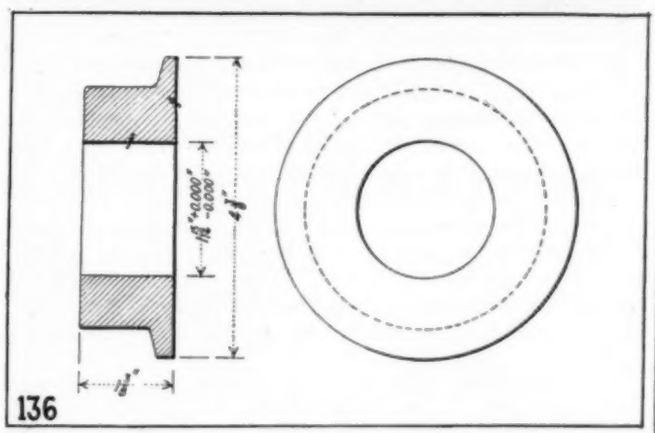
Fig. 123—Geared, friction-head turret lathe. Fig. 124—Tooling layout for first chucking of cast-iron dial. Figs. 125 to 127—First chucking operations on cast-iron dial. Fig. 128—Second chucking of cast-iron dial Fig. 129—Tooling layout for second chucking of cast-iron dial. Fig. 130—Speedometer joint—Interrupted internal cuts. Fig. 131—Tooling layout for speedometer joint

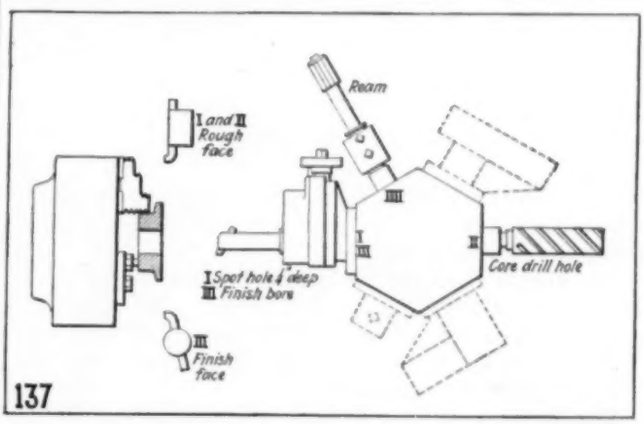


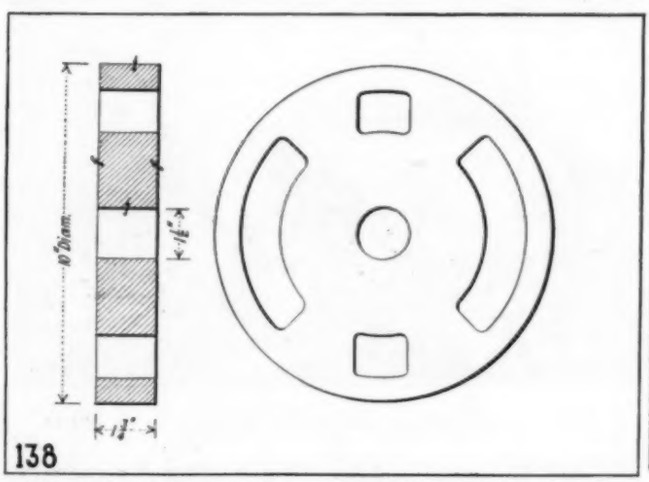












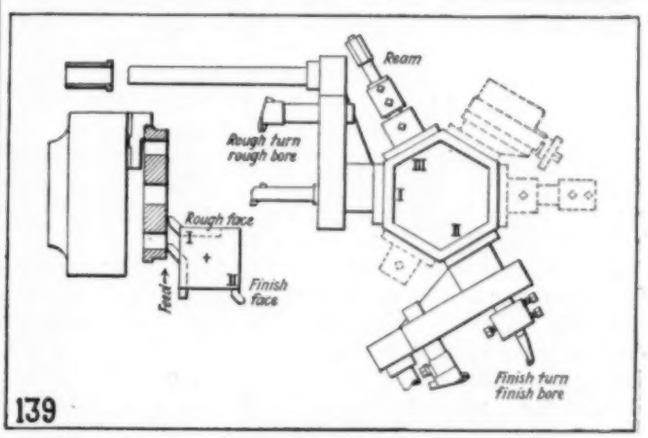


Fig. 132—A typical bronze bushing. Fig. 133—Tooling layout for bronze bushing. Fig. 134—Machine tooled for making bushings. Fig. 135—Other bushings made without changing set-up. Fig. 136—Cast-iron pulley collar. Fig. 137—Tooling layout for pulley collar. Fig. 138—Cast-iron clutch ring Fig. 139—Tooling layout for clutch ring

the tool shank. To do this, an adjustable toolholder, which permits perfect alignment of the tools with the center of revolution of the spindle, is used.

In order to align the 0.195-in. hole with the other two previously-finished diameters, the drill is guided in a bushing inserted in the 0.472- and 0.625-in. holes. The tooling layout is shown in Fig. 131. A two-jaw

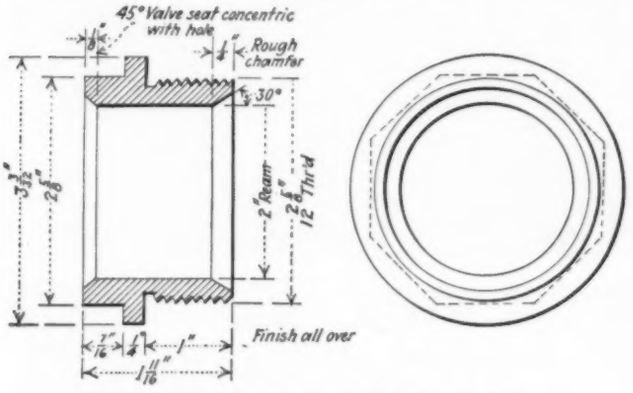


Fig. 140—Valve cage—steel forging

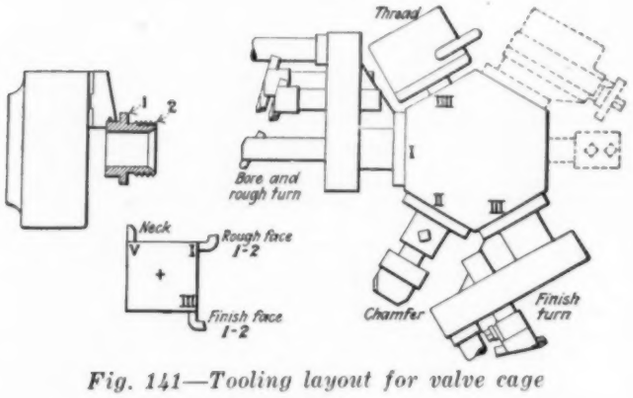


Fig. 141—Tooling layout for valve cage

wrenchless chuck with false jaws, cuts the chucking time to one-third of the time necessary when a plain two-jaw chuck is used.

The simple chucking equipment for the bronze bushing shown in Fig. 132, consists of two slide tools and a reamer, and will produce a great variety of bushings in either small or average lots when used with the universal type of cross-slide.

The bushing is cast with a chucking extension on which the jaws grip the casting while it is being finished in one chucking. The simple layout in Fig. 133 shows the order of operations, the machine as tooled for the job, being shown in Fig. 134. The reamer can be omitted if accurate limits are not required.

Additional work handled by the same set-up is shown in Fig. 135. Bushing No. 2 is made in pairs from one casting, and is not cut in two until the second bushing has been completed in the second chucking.

Bushing No. 3 is gripped on the flange, and in the first chucking the large face, the outside rim, and the hole are finished. Soft jaws are used for gripping during the second chucking, which consists simply of facing the other end of the bushing. When absolutely parallel faces are required on the flanges of such bushings, it is good practice during the second chucking to take a finishing cut over both sides of the flanges.

In making bushing No. 4, the shell is chucked by the flange and the rings are cut off from the shell after boring and turning. The layout gives rapid production on a great variety of bushings with very little set-up time, since the slide tool can be quickly set to accurate sizes by the large, micrometer dial.

The problem in making the cast-iron pulley collar, Fig. 136, is to keep the core drill from following any irregularity in the cored hole and casting. To start the drill true, a boring cut of the same diameter as the drill, is first taken with a single-pointed cutter for a depth of $\frac{1}{4}$ in. The core drill is ground with its cutting edges at right angles with the center line, to avoid deflection.

After the core drill has rough bored the hole, the boring cutter in the slide tool is again used for a finishing boring cut. The tooling layout is shown in Fig. 137. This double use of the same slide tool for boring the two hole-sizes, is quickly accomplished because of the simple adjustment possible from a large, micrometer dial. The solid construction of the slide tool permits the use of heavy feeds. Note the combining of the facing and boring cuts.

The longest operation on the cast-iron clutch ring, Fig. 138, is the facing. The tooling layout, Fig. 139, shows a set-up which is suggested for making this piece in lots of 100, using a hollow-hexagon turret lathe.

Two ordinary forged cutters are mounted in the square turret for the rough facing, as shown in the layout. This arrangement reduces the time by three minutes, as compared with using but one cutter. The extra cost of the second cutter and its added set-up time, makes this method profitable only when at least 40 pieces are made in a lot.

The finishing cut is taken with a single pointed tool, so that there will be no overlapping joint. It is not necessary to change any of the tools in the permanent set-up. The second operation should be done with the same tools, except that soft jaws are substituted.

The use of standard overhead-piloted tools for heavy work like the valve cage shown in Fig. 140, makes heavy feeds possible without loss of accuracy, because torque and overhang are absorbed. One initial investment in two overhead-piloted heads and in four or five inexpensive stub bars, will take the place of many expensive and special piloted-bars.

The valve cage is made from a drop forging; mate-

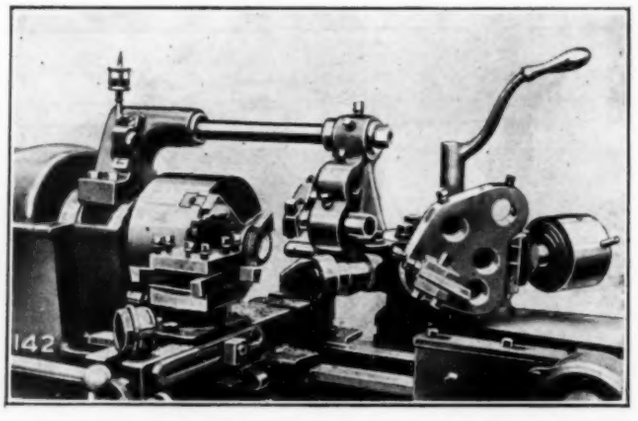


Fig. 142—Machine tooled for making valve cages

rial S.A.E. steel No. 1025. The tooling for the first chucking is illustrated in Fig. 141, and the machine as tooled for the job, in Fig. 142. An ordinary die head is used for threading. The thread ends in the narrow

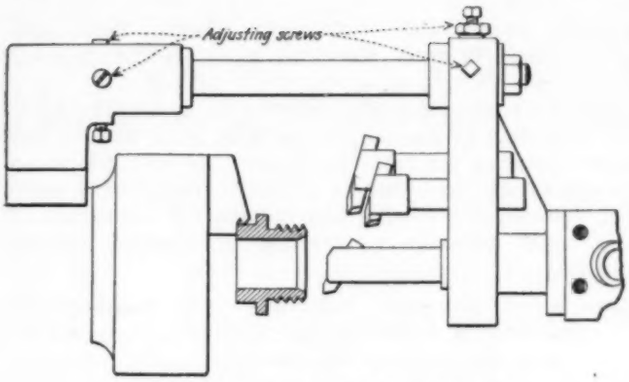


Fig. 143—Overhead-piloted tool

recess close to the shoulder, as shown in the drawing. Hobbed chasers are, therefore, necessary, since they can be ground on their faces without altering the chamfer on the front. Milled chasers are less expensive for ordinary work, but they must be ground in the throat, and therefore are not suitable for shoulder work.

The construction of the standard, overhead-piloted tool is shown in Fig. 143. Note the provision for the adjustment of the overhead piloted bar and the guide bushing. This feature makes it possible to compensate the alignment for wear of the machine. The tool can readily be transferred from one machine to another, or can be installed on an old machine. The tool proper is a standard, multiple-turning head, and the overhead-piloted feature may be added at any time by obtaining the bracket for the head end of the machine and the necessary pilot bar. From this description the extreme rigidity of the tool is quite apparent.

Discounts on School Machinery

By E. P. Blanchard

OCCASIONALLY, there's a discussion about special prices or discounts on machinery, equipment and tools bought by manual training and trade schools and the mechanical departments of universities. This discussion arises from the fact that the manufacturers of such equipment encounter requests for price concessions based on appeals to the generosity of the manufacturer for a worthy cause, or on the value of the influence which the use of specific manufacturers' products will have on the student—either toward providing trained operators with a preference for his make, or toward specifying such equipment during later years in those plants where he may be in a position to influence the purchase.

The matter can be considered from several viewpoints. First, what are the resources of the institution? Is the school supported by taxation or not? What about endowment? Has the school institutional prestige? In what educational function and for what purpose will the students come in contact with the machinery and equipment? Finally, how many of those boys are going to remember the nameplate on the old buzz-saw they were permitted to play with, and even if they did remember, what would it mean to them in later years; and most important, what will it mean to the manufacturer?

In this case, it is quite gratifying to have expressions from certain school authorities, who, in addition to buying equipment, make a life work of knowing what impressions last on the minds they are molding. Such expressions as have been obtained are a peculiar mixture of ethics, economics and erudition.

Discounts on equipment used for educational purposes originally came into practice when trade education was in its promotional stages and sought the interest of the manufacturers and builders who appreciated the necessity of training youth in trade processes. Many of these men were willing to contribute to the cause of trade education, realizing that in a measure, it lightened their own burden of apprentice training.

The functions of equipped schools, however, do not consist solely of trade-training. Manual training is distinct from it and becomes but a part of a more-or-less diversified general education. University students, however, will take manual training with the idea of teaching it at some later date, and consequently they make a point of knowing not only the types of machines, but the names of the builders. Others have, as a primary objective, the acquiring of skill in working with their hands, and make little or no attempt to distinguish the makes of equipment which they use.

Depends on a Source of Support

It is generally agreed that in schools maintained by public taxation, there should be no urge for discounts or contributions, although assistance of this form, if offered voluntarily, may properly be accepted on the part of the schools. Schools operating under conditions of endowment, tuition or otherwise contributed support, constitute a slightly different problem as regards donation, and the interest and attitude of the manufacturer toward any particular project.

But outright gifts are beside the question except when they are made with the expectancy of some return, or are ever-so-gently coerced with the suggestion of some return through the influence of having certain machines "among those present." It is then that the manufacturer desires to establish some value on that influence. The value received would naturally be in the form of prestige in choice of equipment by a school of high standing or in the influence exerted through familiarity with it in the minds of the students.

Referring to the second phase—influence on the student—it is only natural that he should acquire certain preferences. In the trade school this may be a preference which will lead him to the ultimate operation of one machine rather than another, and it may persist as an opinion for considerable time. But in the period between school years and the time when the student is in a position to influence the purchase of equipment, there is every opportunity of change. There are changes in designs of tools and in their purposes; there is progress in manufacturing methods; and there is the chance that the manufacturer who was a leader during school years may have gone through a period of decline.

Whatever impressions are made by personal contact with machines installed in school shops under artificial manufacturing conditions are readily overshadowed by an opportunity to see the same and other equipment in actual operation in quantity and quality production, or in maintenance work.

Therefore, the school experience is a poor criterion on which to judge specific items of equipment years later. It requires a new analysis under the later conditions.

Book Reviews

A Treatise on Dimensioning. By John F. Faber. Ninety-one illustrations, 64 pages, 6½x10½ in., paper cover. Published by the Bruce Publishing Co., Milwaukee, Wis. Price 68c.

Drawings, as outlined by the author, should be dimensioned with the thought in mind that some mechanic is going to work from them, that the drawing is made to aid him in his work, and that it must fulfill this function properly. The importance of dimensioning on mechanical drawings, therefore, is treated with a view of avoiding confusion, costly errors and loss of valuable shop time that result from the improper placing of dimensions.

The student who has not had sufficient mechanical training to guide him in dimensioning drawings should find the manual of value. The exercises are planned to offset this lack of experience and to develop a fair degree of skill in dimensioning through the application of practical rules.

The illustrations are the result of lessons successfully used for a number of years and offer an opportunity of teaching dimensioning in a series of short lessons.

Principles of Metallurgy of Ferrous Metals, a manual for Mechanical Engineers. By Leon Cammen, M.A. One hundred and forty-five pages, 6x9 in., cloth covers. Published by the American Society of Mechanical Engineers, 29 West 39th St., New York City. Price $1.50 to members; $2 to non-members.

As the subtitle states this book was written particularly for the mechanical engineer in the general sense, who deals with ferrous metals as a designer and constructor, rather than a specialist in the manufacture of steels or cast irons. Hence the style is somewhat popular in an engineering way, although it would mean nothing at all to a layman. Mr. Cammen has attempted to review in a condensed manner the tremendous advances that have been made in the art during the past decade. He has spared no effort to cover all that has been published in either book or journal form both in English and in German as late as the Fall of 1925, as is indicated by complete bibliographies at the end of each chapter. This feature alone makes the book quite valuable as a reference work. The limitations of the reader are recognized to the extent that the text is presented in an understandable style. The author has succeeded in stripping such highly scientific subjects as the X-ray analysis of crystal structure of much of its complexity, so that the reader can obtain an intelligent grasp of the subject in the course of a few pages. In those cases where there is a disagreement as to which of several theories are correct, all are stated impartially.

The book is divided into six chapters. The first deals with the so-called physico-chemical properties of iron alloys; this is a general review of the microstructure of steels and the familiar constitutional diagram. Chapter two treats of the latest field of discovery and experimentation—crystal structure. This idea is carried over to the chapter on the determination of various properties, together with descriptions of the methods of investigation by means of microscopy, X-rays, magnetic analysis (a new field) and many others. Heat-treatment follows in order, then cast irons, and finally alloy steels.

By the time one has finished a study of this book, he feels that he has caught up with a lot that he has missed during the last few years. He will not be an expert metallurgist, but he will have enough of a working knowledge to enable him to take full advantage of the latest advances in the art of treating ferrous metals.

Accounting Systems: Principles and Problems of Installation. By George Bennett, professor of accounting, College of Business Administration, Syracuse University. Five hundred fifty-four pages, 5½x8½ in., flexible binding. Published by the A. W. Shaw Co., Chicago, Ill. Price $7.50.

A non-technical treatise on the practical application of numerous principles of constructive accounting from the viewpoint of the average trading, service, and manufacturing business. A variety of situations and problems confronted by the system accountant in his daily work are shown. General theoretical principles are curtailed vigorously, inasmuch as a host of elementary books cover this subject in detail. But since numerous readers and students are in serious need of reviewing these general principles prior to attempting any problem work, certain fundamental matters are discussed.

After an introductory chapter dealing with the steps in correct system design, and in installing a system, the author deals with the actual operation of a system. He takes up each record book, describes its use in the system, tells how it should be columnized and shows the relation of columnization to control. He indicates how to handle check and cash payments, disbursement records, and cash receipts; shows what elements should be considered in cost accounts, and outlines effective methods for recording material, labor, overhead, and completed orders. Internal check factors for purchases, returns, sales or sales returns, cash disbursements, cash receipts, are considered.

Actual systems of accounting for representative businesses are shown. For example, there are accounting systems for a retail store, a commission business, a factory, a garage, a foundry, a machine shop, and so on, with the general scheme behind each system. Throughout the book are 97 forms which, while not to be adopted and applied to actual problems, nevertheless are essential in furnishing the reader with tangible ideas of where to begin and how to proceed in designing needed forms.

Popular Research Narratives. Tales of Discovery, Invention and Research. Vol. II. One hundred sixty-nine pages, 5x7 in., cloth boards. Collected by the Engineering Foundation, 29 W. 39th St., New York City. Published by the Williams & Wilkins Co., Baltimore, Md. Price $1.

The second volume of "Popular Research Narratives" consists of fifty brief stories of research, invention, or discovery written for the layman. The stories are written by the men making the research, invention, or discovery, or upon information obtained directly from them.

To spread knowledge of science, engineering, and invention, and of their contributions to the welfare of men is the object of the narratives. They are intensely interesting and of great value educationally.

Handling Chilled Car Wheels in the Shop

By Frank C. Hudson

Suggestions as to standardizing shop practice, as to allowances for press fits, for boring wheels and for turning axles in the railroad shop

THE importance of chilled-iron car wheels can be somewhat understood by considering that there are over 22,000,000 of them in service in the United States and Canada, in freight-car service alone. In addition, there are thousands in use under locomotive tenders, as well as under passenger and street cars. The proper handling of chilled car wheels in the railroad shop thus becomes an important problem.

The only machine work a chilled car wheel requires is boring the hub to receive the axle, which is forced in at a predetermined pressure. Although boring is a simple operation, it requires careful attention, for the hole must not only be of the right diameter, but it should be concentric with the tread, and at a right angle to the vertical axis of the wheel. Otherwise, the wheel will not run true when mounted. It will either be eccentric or wabble as it turns with the axle. If, on the other hand, the bore is not round, or is irregular, the axle may go in at too low a pressure to hold the wheel securely while in service, or the wheel may burst while being mounted.

The car-wheel boring mill should be of a heavy type, with a suitably designed spindle. Five chuck jaws are generally used, and they should frequently be tested to be sure that they are true as well as holding the wheel so that the hole is bored at a right angle to the flange. The cutting speed of a car-wheel boring mill can rarely exceed 40 to 50 ft. per min. Table I shows the approximate number of revolutions necessary to secure cutting speeds of 40 ft. per min. when boring the hubs of axles from 3 to 7 in. in diameter.

All fins should be chipped off from around the hub of the wheel before it goes to the boring-mill table. The wheel is placed on the table with the flange up, and should be carefully centered and also tested for warpage. High-speed cutting tools should be used, and they should be ground in accordance with the best practice. From $\frac{1}{4}$ to $\frac{3}{8}$ in. can be removed in the roughing cut. The finishing of the bore is usually done in two cuts, which should be considerably lighter, not exceeding $\frac{1}{8}$ in.

Table I—Revolutions for Cutting Speed of 40 ft. per Minute

Bore	R.P.M. of Boring Mill
3 in.	51
3½ in.	45
4 in.	38
4½ in.	33
5 in.	30
5½ in.	28
6 in.	25
6½ in.	23
7 in.	22

In mounting new wheels on old axles, it is generally considered better practice to bore the wheels to fit the axles than to turn the axles to fit the wheels since this method usually saves time, and also prevents reducing the diameter and strength of the axles, as occurs when the wheel seats are turned down. The bore is usually finished with a standard micrometer boring bar.

In some shops, it is the practice to rough and finish bore a wheel with both cutters working at the same time, since this method gives a somewhat greater output per machine. Best results are, however, secured by taking the last finishing cut independently. In some cases, both roughing and rough-finishing cutters are used just before the final cut, the rough-finishing cutters being set to about 0.04 in. below the finished size. The final cut is taken with the finishing cutter alone. A type of caliper for car-axle journals is shown in Fig. 1. The points are provided with hardened rollers, and a multiplying lever, as at *A*, used on one leg, the readings being taken on the scale by the pointer *B*. With these calipers, limits can be set that will insure the fit of wheel and axle when both are straight and round. It has been recommended that axles on which any two parts of one wheel seat vary more than 0.003 in. in diameter, or a seat that is 0.001 in. out of round, shall be considered unfit for mounting. Wheels, the bores of which show more than 0.002 in. difference in any two points, shall also be rejected. Both the wheel seats of axles and the bores of wheels should be gaged at three points—at 1 in. from each end of the wheel seat, and in the center.

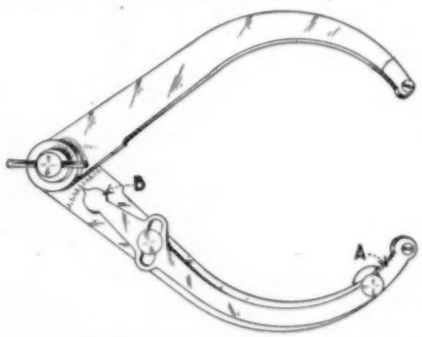


Fig. 1—Calipers for car-axle journals

In railroad shops, the greater part of the work on axles is in turning them, either for fitting new wheels or for refinishing journals that have become worn or cut. The first consideration is to insure the axle being tight in the wheel during its life in service. At the same time, the metal in the axle must be conserved to the utmost. The value of a new 50-ton axle is approximately $28 while its scrap value is only one-quarter of the new value, or $7. The cost of the service secured from each axle is, therefore, approximately $21, plus the labor expended on it.

The life of the axle is represented by the difference in diameter between a new wheel seat, and the smallest diameter at which it can be used safely. The limit of safety in axles for cars of 100,000-lb. capacity is approximately ¼ in. A little figuring will show that if the wheel seats are reduced ¼ in. in diameter, the metal removed will weigh about 12½ lb., and, considering both the new and the scrapped value of the axle, it is worth about $1.70 per pound.

Table II—Wheel Weights and Diameters of Cored Holes

Maximum Gross Weight of Car, Pounds	Core, Inches	Maximum Weight, Pounds	Minimum Weight, Pounds
103,000	5¼	650	640
136,000	6	700	690
169,000	6½	750	740
210,000	7⅛	850	835

Table III—Pressure for Mounting Wheels

Axle	Wheel Seat Diameter	Chilled-Iron Wheels Minimum	Chilled-Iron Wheels Maximum
A	5¼ in.	30	45
B	5⅜ in.	35	50
C	6½ in.	40	60
D	7 in.	45	65
E	7⅜ in.	50	70

Table IV—Maximum Wheel Loads

Weight of Wheels in Pounds	Maximum Wheel Load in Pounds	Car Capacity in Tons
650	12,875	30
700	17,000	40
750	21,125	50
850	26,250	70

While the diameter of the wheel seat may not always be the cause of scrapping the axle, the removal of the smallest possible amount of metal is always of the utmost importance. The question of the slightly increased cost of machining is of much less importance than the saving of metal in the axle.

Lathes used in turning axles should be very carefully tested for alignment, since a tapered wheel seat is to be avoided if proper fits are to be secured. Tapered wheel seats are occasionally responsible for wheels bursting while being pressed on. The importance of straight wheel seats becomes more evident when we consider that in a steel wheel having a 7-in. bore, the wheel seat on the axle must be about 0.007 in. larger than the bore, while for a chilled-iron wheel it must be 0.015 in. Each 0.001 in. in diameter affects the mounting pressure approximately 10 per cent.

The mating of wheels is quite important in order to secure wheels of as near the same outside diameter as possible on each end of the axle. Wheels are measured by what is known as their "tape" size. Steel tapes are used around the circumference, and variations from the standard diameter are noted by ⅛-in. divisions on the tape. These divisions are numbered I, II, III, IIII, etc., and the wheels, when shipped by the manufacturer, are stencil marked with the tape size. Thus, each tape size, or "tape" as it is frequently called, denotes ⅛ in. difference in circumference, or 0.0039 in. in diameter. Some makers consider the correct mating of wheels so important that they are advocating making the tape divisions 1/16 instead of ⅛ in.

The standard chilled wheel is 33 in. in diameter or 103.67 in. in circumference. When a wheel measures within one "tape" (⅛ in.) either side of the mark 33, it is designated as a tape-3 wheel. The smallest acceptable wheel is tape 1, and the largest is tape 5. The wheels have five small lugs cast on the hubs and lugs are cut off until those left represent the size of the wheel. If all five lugs remain it is a tape-5 wheel.

In Table II, weights of wheels and the diameters of the cores are given. A careful selection of wheels for mounting materially increases their life, reduces strain resistance, and also reduces the tendency to sharp flanges. If one wheel of a pair is one tape size greater in circumference than its mate, there is a slippage of 6 ft. per mile. If the wheel gives its expected performance of 60,000 miles, the slippage would approximate 70 miles. In reality, however, the slippage reduces the diameter of the smaller wheel, so that the difference is continually growing larger and materially shortening the life of that wheel. In addition, the small wheel grinds the rail and emphasizes the desirability of having both wheels as nearly of the same diameter as is possible.

In mounting new wheels, only those stenciled with the same numbers should be mounted on the same axle. With second-hand wheels, the standard tape should be used to select mates as nearly alike as is possible. The maximum variation should not exceed 1/16 in. in circumference. Care should be taken to see that wheels are pressed on at the proper distance apart. The allowable play is ⅜ in. for a track gage of 56½ in., the wheel gage being 56⅛ in., measured ¼ in. above the base line.

In Table III, the pressures recommended for pressing chilled-iron wheels on their axles, are given.

When a wheel is half way on, the pressure should be within 5 tons of the minimum pressure allowed, and the final pressure should not be less than the pressure shown on the gage at any intermediate point.

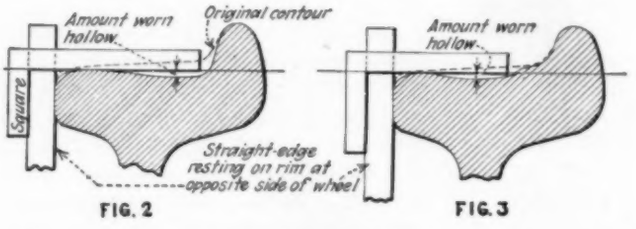


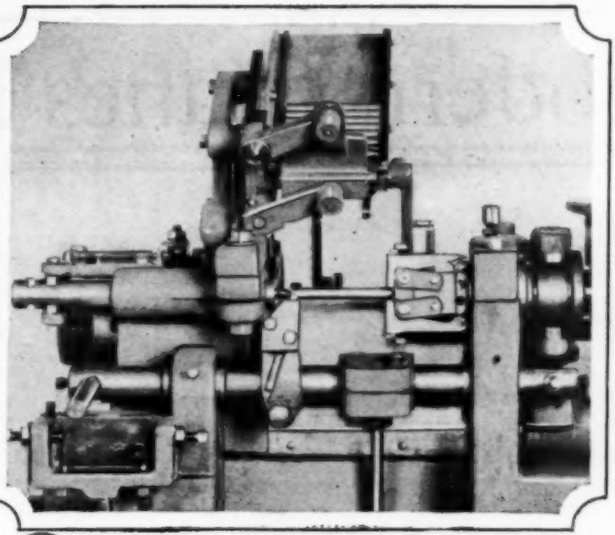
FIG. 2 FIG. 3

Figs. 2 and 3—Approximate methods of determining wear on tread

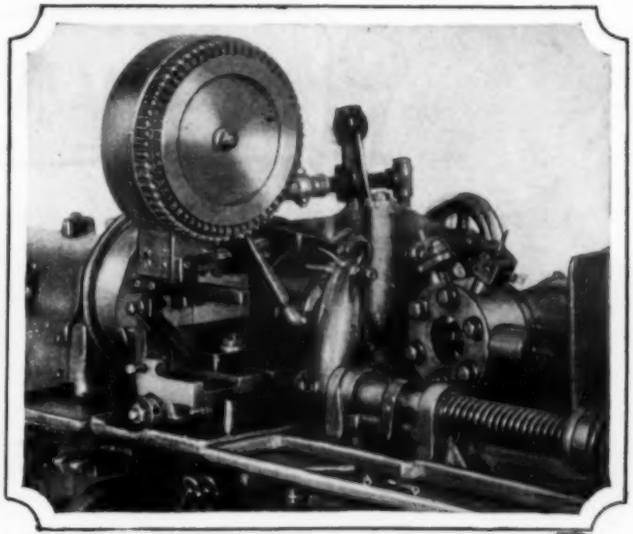
There are four standard weights for chilled iron wheels, to cover all the varieties of freight cars now in service, and in Table IV these standards, as approved by the American Railway Association, are given.

Since there has been some question as to the best way of measuring the amount of "hollow" on wheel treads, the following method is recommended by the manufacturers. Both Figs. 2 and 3 show the use of a steel square in connection with a straight-edge extending across the wheel and resting on the rim at both points. The square is placed against the straight-edge, as shown, and allows the amount of "hollow" to be readily determined. Fig. 3 is similar to Fig. 2, except that a square with a shorter blade is used, on account of the hollow being in the center of the tread. The author is indebted to the Association of Manufacturers of Chilled Car Wheels for much of the information given.

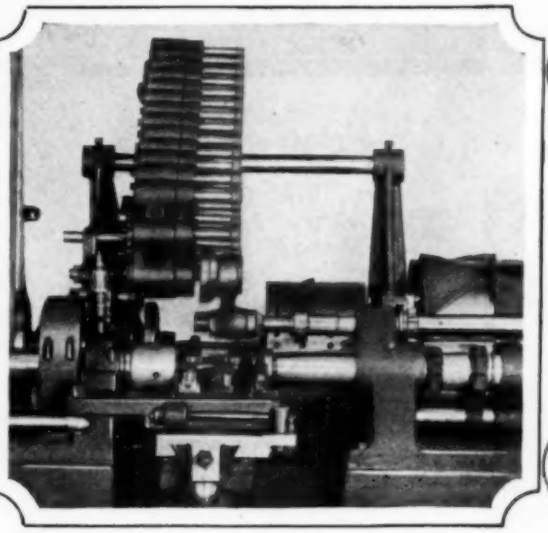
Magazine Feeds



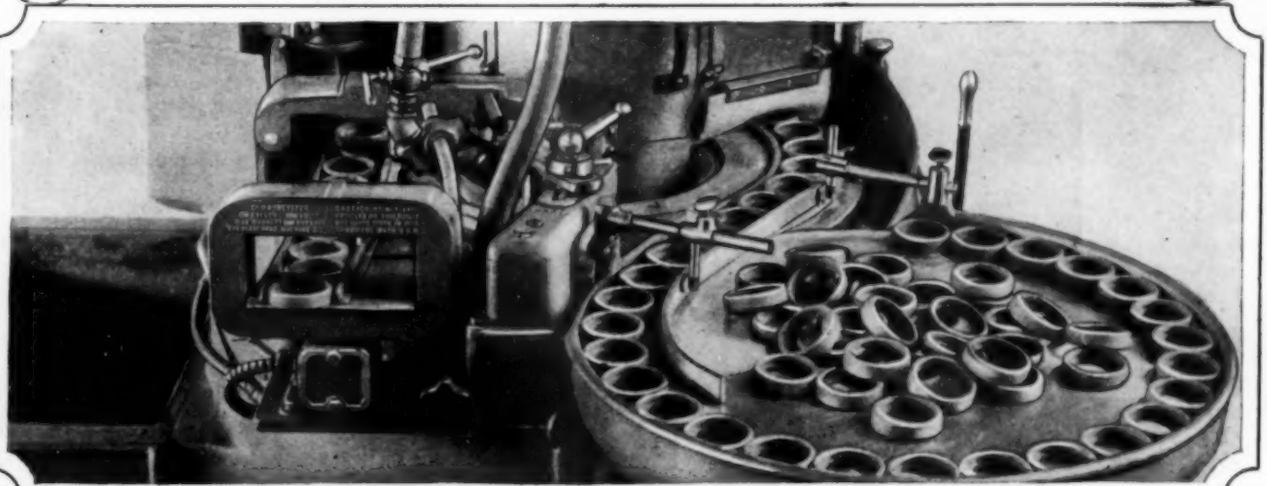
1—Townsend lathe equipped with magazine feed



2—Circular magazine on Browne & Sharpe automatic

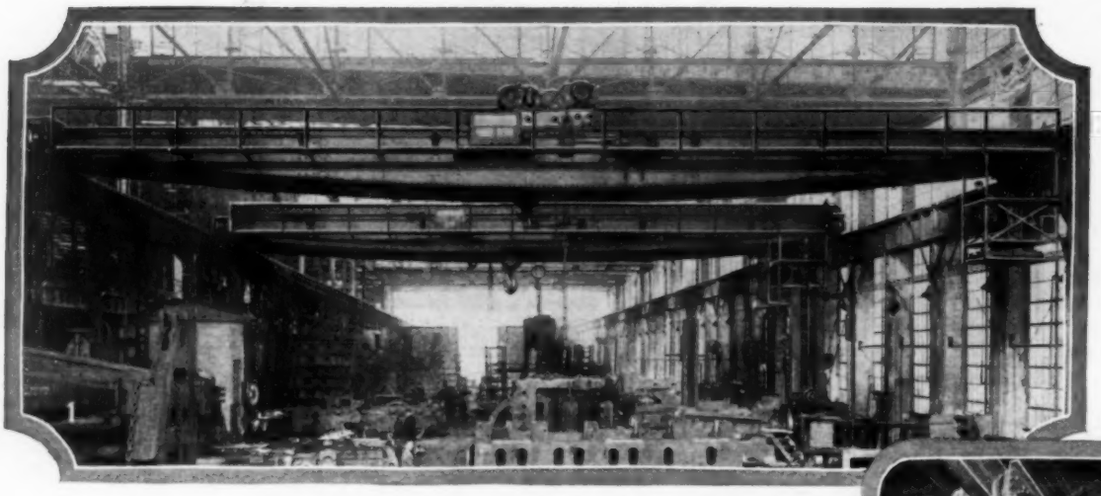


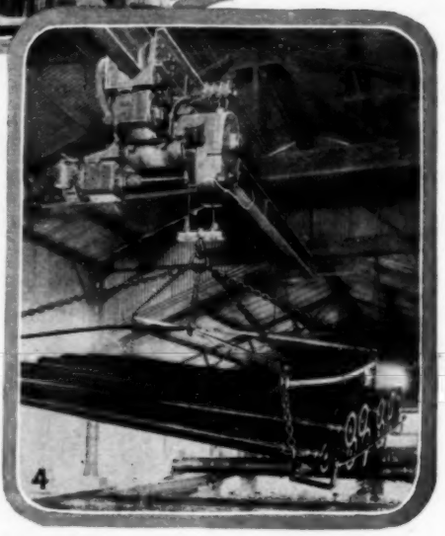
3—Rotary tilting magazine on Cleveland automatic



4—Dial loading device on Blanchard grinder

Modern Cranes in



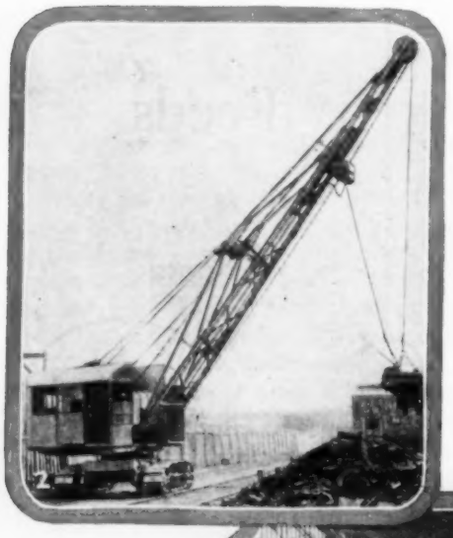


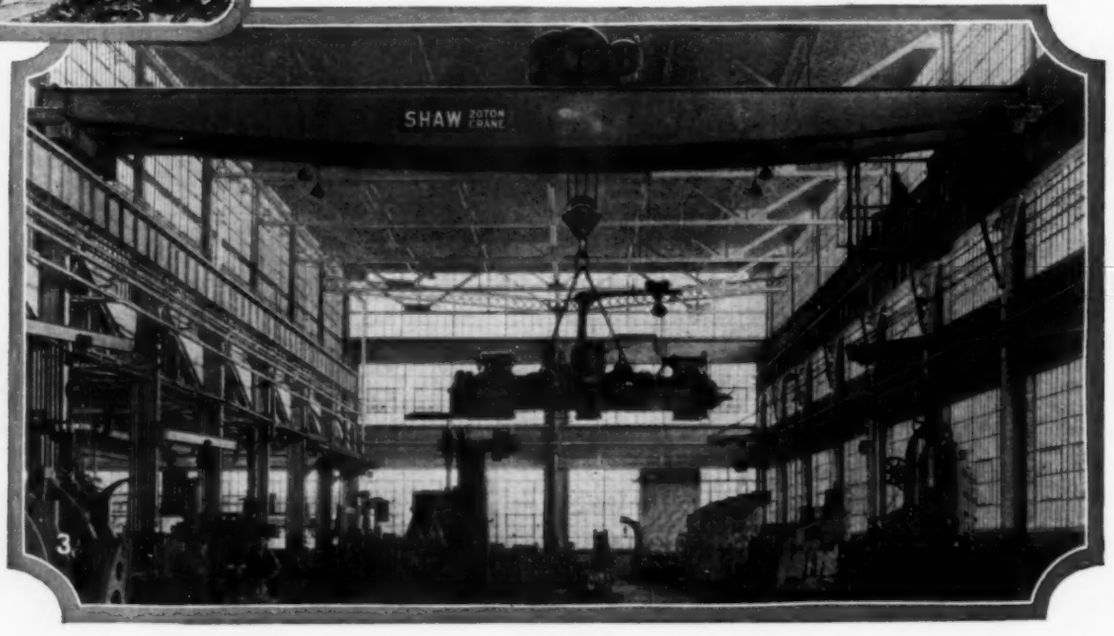
1—Two 15-ton cranes, equipped with 3-ton auxiliary hoists, used for handling a variety of large work in the shop—Harnischfeger

2—Tractor-type crane equipped with magnet. The controlling generator is operated by a gas engine—Harnischfeger

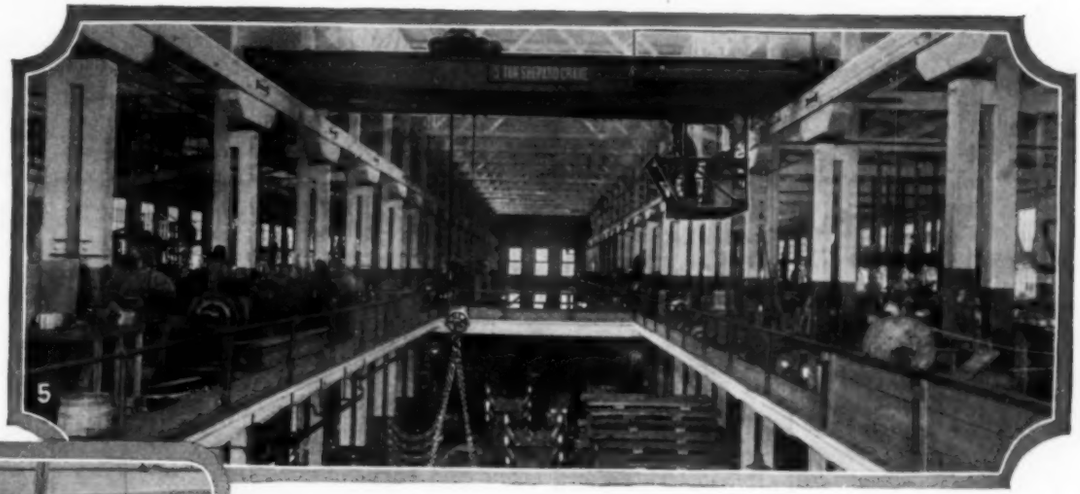
3—A 20-ton crane in a machine tool shop—Shaw

4—Single I-beam crane, floor controlled—Harnischfeger





and out of the Shop

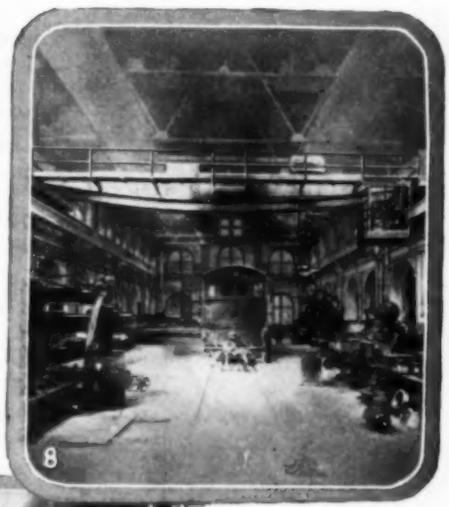


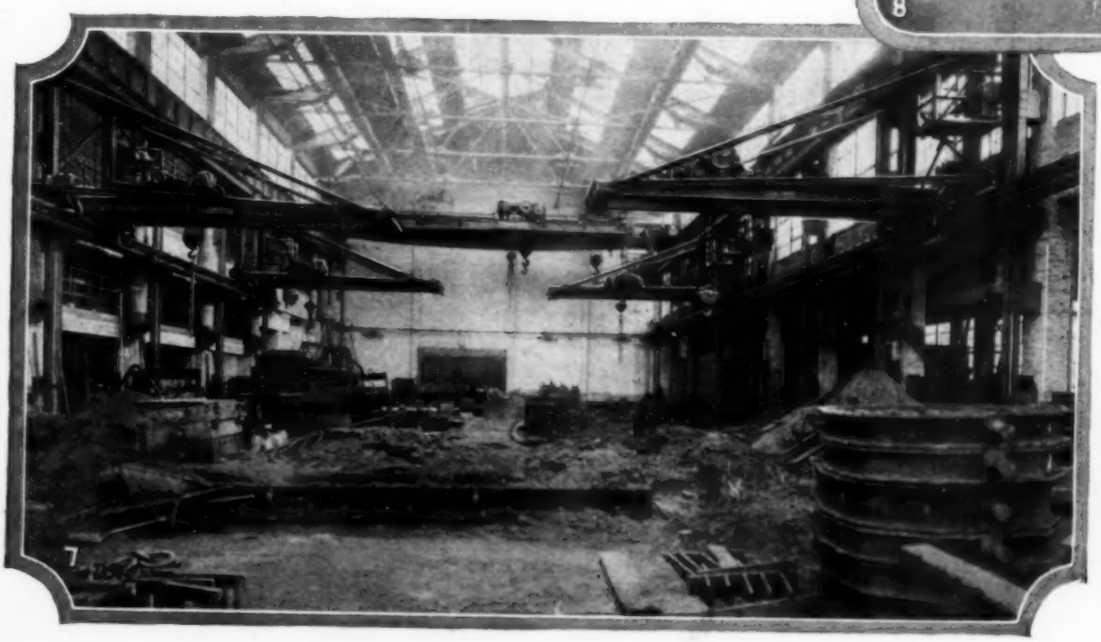
5—A 5-ton, 3-motor crane in electric manufacturing shop—Shepard

6 — Floor-operated double-motor crane—Shepard

7—A 60-ton traveler and four 5-ton wall cranes in foundry—Shaw

8—A 10-ton crane in Watertown Arsenal—Whiting





The Manager's Handicap

BY E. P. BLANCHARD

The manager sits on the office stool
And yearns and yearns and yearns
For a chance to buy a modern tool
That earns and earns and earns.

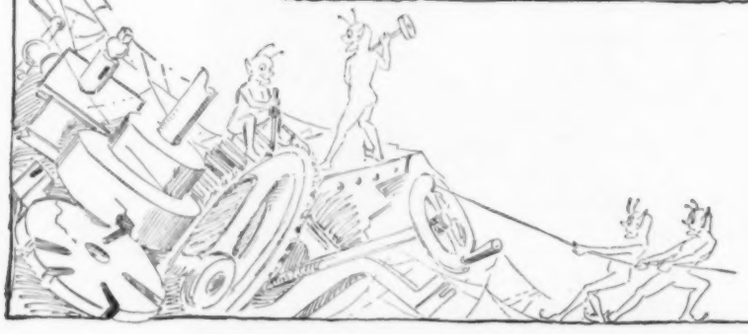
He's sick of fussing with old-time stuff
And slow production has called his bluff,
He knows there are profits he's sure to muff
When the trend of business turns.

While the orders come at a generous price
He drives and drives and drives,
So the books will show just a little slice
He plans and schemes and strives.

He's got to earn while the price is right
When everyone's pushed with the work in sight,
But when competition brings on a fight
He'll be lucky if he survives.

His boys will do what he wants them to
And they work and work and work,
But they're penalized by his old machines
For the damn things only shirk.

So do what he will, production's low,
He hasn't a chance till his old tools go
To that far-off land of lost limbo
Where only phantoms lurk.



Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Milling Fixtures for Washing-Machine Parts

BY J. A. JONES

The illustrations show a couple of fixtures that were designed to hold the housing of a washing machine while milling. The machine used is a Cincinnati 24-in. Duplex.

In Fig. 1, the bottom of the part is being milled with a 7½-in., inserted-tooth face mill, at the rate of

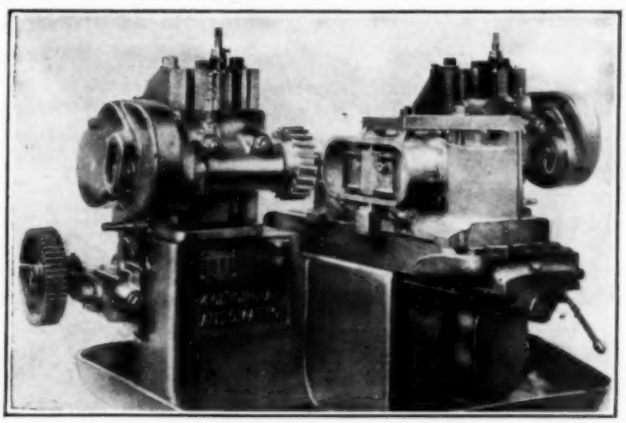


Fig. 1—Milling base of housing

15.3 pieces per min., floor-to-floor time. The material is cast iron. About ⅛ in. of stock is removed and the finish is fairly smooth.

In the base of the fixture there are three fixed supports upon which the work rests, and there is one adjustable support that is necessary to compensate for slight irregularities in the castings. Fixed gaging points at each end locate the piece, which is held down by the quick-operating clamps as shown.

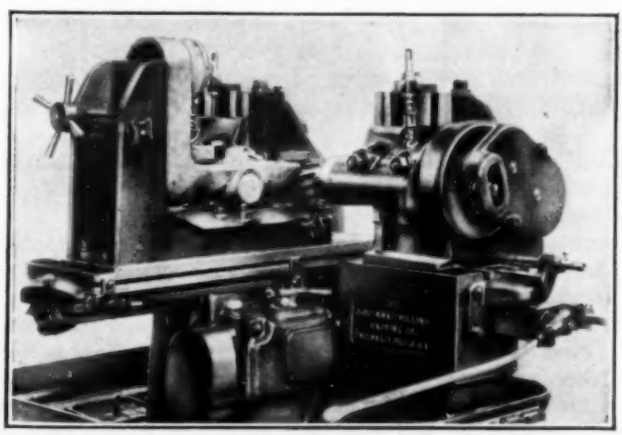


Fig. 2—Milling the side pads

In Fig. 2, the same piece is shown in a somewhat different position, to mill the side pads. In this case the fixture is made in the form of an angle plate, against the vertical surface of which the previously milled bottom of the piece is clamped. There is one fixed support at the foot of the angle plate and two adjustable supports under the horizontal leg of the work. Fixed stops on the angle plate square up the work.

Two end mills remove about ⅛ in. of stock from each pad. The production is at the rate of 27½ pieces per hour.

Babbitting a Large Bearing

BY J. E. PAYNE

At one of the plants of a large stone-crushing company, it was found necessary to rebabbitt one of the bearings of a crusher, said to be the largest of its kind in the world. The facilities at the plant were inadequate for the work and it was decided to send the machine to the Brooklyn works of the United American Metals Corporation.

The bearing, by reason of its design, would of necessity have to be poured while in a vertical position. The height of the bearing, after it had been placed in position for pouring, was about 10 ft. And it required about 1,200 lb. of babbitt to line it. The problems that presented themselves, after the old babbitt had been chipped and melted out, were heating the shell and mandrel, damming the lower part of the bearing to keep the metal from running through, and casting the bearing in a single pour. The first problem was overcome by resting the bearing on a pair of rails and building a charcoal fire underneath. The second problem, damming the lower part against the molten metal, was handled by cutting out a sheet-iron disk and jacking it tight up against the shell. A hole had been cut in the center of the disk to permit the heat from the charcoal fire to run clear through the shell and mandrel. To have simply dammed it with putty or clay, as is usually done with smaller bearings, would have been of no avail, since the weight of the metal would have caused it to break through and run out as fast as it was poured. In minor parts, however, where it was necessary to seal against the metal, rope was stuffed into the space, and around the rope was packed putty, stiffened with cement. The last problem, that of casting the bearing in a single pour, was the most difficult. The bearing might have been cast by pouring with ladles but such pouring leaves heavy seams, and there is always the danger of the bearing breaking at one of these seams. This problem was met by dismantling

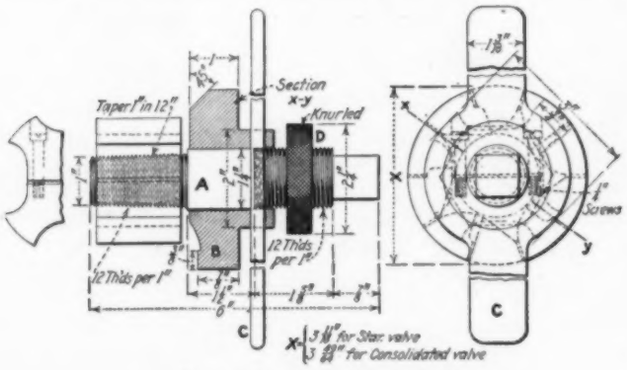
a bottom-pour, gas-heated melting pot of sufficient capacity to hold the required amount of babbitt, and elevating it to a platform built to a height so that the spout would look down into the space between the shell and the mandrel. A gas connection was made, the babbitt heated to its proper temperature, the valve at the spout opened, and the metal poured down in a steady stream against the mandrel, first slowly, then faster, until the space nearly filled, after which the stream was gradually slackened. The metal was permitted to overflow in order to take up the shrinkage as it cooled.

Tool for Reseating Pop Valves

BY FRANK C. HUDSON

A very handy tool for reseating pop valves without putting them in the lathe is shown herewith. It consists of a central stud *A*, threaded at each end and having a straight, smooth place in the center, 1¼-in. diameter and 1¼-in. long. One end has a straight thread and the other a thread that tapers 1 in. to the foot.

On the taper end is a pilot that fits into the opening in the pop valve, the pilot being in halves that are expanded by the taper thread until it is tight in the bore of the pop valve. The central stud then becomes a



Pop-valve reseating tool

guide for the cutter *B* which is turned by hand, using the lever *C*. The knurled nut *D* is used to hold the cutter firmly against the seat being refaced.

The cutter has two sets of four teeth. One set is at 45 deg. angle and the other set is flat. The tool is easy to use and can be quickly put in place and removed.

This tool is used in the Grand Trunk Railway shop at Battle Creek, Mich., having been devised and made by one of the men in the toolroom.

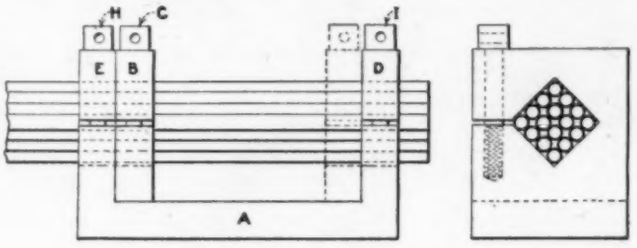
Fixture for Holding Tubes

BY ARTHUR KENDALL

We had to cut a lot of ¼-in. tubing into short lengths, and the fixture shown in the sketch was devised for holding sixteen tubes at once, in a rather unusual manner.

The fixture is composed of the U-shaped base *A* and the sliding piece *B*, both of which have diagonal, square holes in them of a size to hold sixteen of the tubes. Both parts are slotted on one side and provided with binding screws as shown. The distance between the legs of the *U* is such as to allow the piece *B* to slide an amount equal to the length of the pieces of tubing to be cut off.

In operation, the tubes are passed through the square holes in each of the parts, protruding to the line of travel of the saw or cutter, and the sliding piece *B* moved against the leg *E*. By tightening the binding



Fixture for holding tubes

screw *C* and moving the piece *B* against the leg *D*, as shown by dotted lines, the tubes will be moved forward a distance equal to the length of the pieces to be cut off.

After tightening binding screws *H* and *I*, the cutting can proceed. After the cut has been made, loosening binding screw *C* and moving the piece *B* to its former position against *E*, tightening binding screw *C* and loosening binding screws *H* and *I*, the tubes can again be brought to the cutting position. This procedure can be continued until the tubes have all been cut to length.

The fixture can be used in either a power hacksaw or a milling machine.

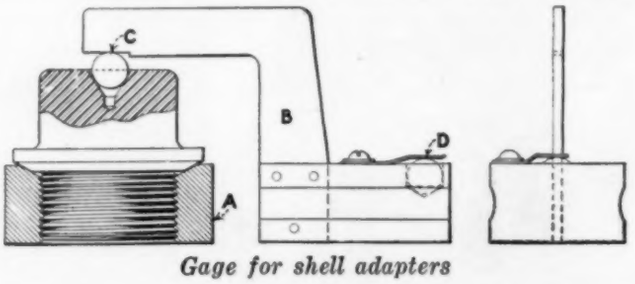
Gage for Shell Adapters

BY E. N. DAVEY

Some years ago we were machining 6- and 8-in. shells, and in order to support them while turning the profiles, it was necessary to use plugs or adapters screwed in the noses, to engage the tail center of the lathe. Hundreds of shells were rejected by the inspectors because the profiles were not in the proper position in relation to the other parts.

The trouble was traced to variation in the depths of the center countersinks in the adapters. In order to maintain uniformity I designed and made the very simple gage shown in the illustration.

The cast-iron ring *A* was bored large enough to allow the adapter to slip in, and the upper face was



Gage for shell adapters

countersunk to fit the beveled shoulder of the adapter. The thickness of the ring was such as to allow the adapter to rest in the countersink. The gage *B* was made so the part of the arm at *C* would just pass over a steel ball placed in the countersink of the adapter. Other parts of the arm were ground to allow a few thousandths variation between them and the ball. When not in use, the ball was kept in a hole in the base of the gage by a flat spring, as at *D*.

Characteristics of Bakelite and Its Compositions

BAKELITE is a synthetic product formed from formaldehyde and phenol or carbolic acid. These substances under certain conditions form a resin-like material that solidifies or hardens by the application of heat. Bakelite is infusible, insoluble, impervious to water and chemically inert. In the pure form it is transparent and amber-like in appearance. It is a non-conductor of electricity and has a great mechanical strength.

The Bakelite Corporation produces only the primary or unfinished materials that are made into finished products by various concerns. Laminated Bakelite products are made under the trade names of Bakelite-Dilecto, Celoron, Fibroc, Formica, Micarta, Phenolite and Spaulding Bakelite. These products vary slightly in their structure although they carry similar characteristics. Dilecto is a composition of Bakelite and sheets of tough paper, Micarta contains paper or cloth, Celeron is made of layers of impregnated woven fabric and Fibroc is Bakelite mixed with asbestos.

The usual forms of Bakelite are sheet, rod, tubing and specially-shaped molded products. Some of its uses are for automotive parts, radio equipment, typewriter parts, electrical instruments, pump parts, plating equipment, instrument parts, handles for tools, furniture parts, racks, gears, machine parts and similar units.

The various forms of Bakelite are, a molding material that is a plastic in powder or sheet form, a varnish that is liquid in body, an enamel, a lacquer that is a transparent liquid, and a cement that is a semi-liquid.

Laminated or sheet Bakelite varies in strength according to its composition but the average products have a tensile strength of 12,000 to 14,000 lb. per sq.in. and will withstand a compression of 40,000 to 50,000 lb. per sq.in. Molded materials likewise vary, but will average a tensile strength of 4,500 to 5,000 lb. and will withstand a compression of approximately 25,000 lb. The co-efficient of expansion is 0.00003 in. per deg. C. The specific gravity is usually 1.35. Bakelite will resist acids, chlorine and weak alkalies. It is unaffected by oils, water solvents and most chemicals. When it is heated to 300 deg. F. it is unaffected and will not decompose, whereas higher temperatures will tend to slightly char the surface.

In molding Bakelite, the mixed ingredients are placed in a steel mold, then squeezed under pressure of 2,000 lb. per sq.in. The mold is heated to a temperature of 350 deg. F. causing the mixture to solidify. Hydraulic presses are most commonly used for the operation.

Bakelite varnish is used for coating and impregnating such work as electric coils and windings. It is highly dielectric and heat-resisting. Baking is recommended when it is desired to harden the coated parts. Bakelite enamel is an opaque coating applied to metal surfaces to form a protection against corrosion and chemical actions. It is applied to the work, then baked at 250 deg. F. Bakelite lacquer is a hard, transparent coating applied where a highly-finished surface is desired. It is baked at 275 deg. F. for 20 min. after it is applied. Bakelite cement is used for special applications, such as bonding glass, metal and porcelain. It also requires baking to complete its function.

Some forms of Bakelite are used for gearing, and the makers state that such gears when properly made and installed will run silently, and, owing to their elastic properties, will withstand shocks that might destroy metal gears. Further, they recommend that sound mechanical principles be followed in the application of the gears; that proper alignment be maintained; that the tooth profile be standard; that they mesh with metal gears having cut teeth; that they mesh with gears of equal or wider face; that the backlash be properly controlled; and that proper lubrication be maintained.

Bakelite gear stock is furnished in standard sheet sizes, blanks sawed to size, and in molded blanks.

Bakelite products can be machined without difficulty, but in most cases they should be run at a high speed. The work should be supported close to the cutting tool to avoid flaking. When drilling, it is advisable to support the work where the drill breaks through, and to use a fine feed and a high cutting speed. Tools for general machining operations should be ground with greater clearance than is the usual practice for steel. Bakelite will take a high polish when sanded and buffed, or a dull finish when rubbed with pumice stone and water.

Metal parts can be embedded in Bakelite in the molding process. A mold having highly polished surfaces, yields a molded object having a lustrous finish in which every detail of the mold will be faithfully reproduced.

Bakelite is made in three grades, denoted by letters:

Bakelite A is obtained by prolonged heating below 100 deg. C., and is viscous when hot; solid and brittle when cold.

Bakelite B is formed by keeping Bakelite A slightly above 100 deg. C., and is a resinous product that softens without melting when heated. Thus it can readily be molded.

Bakelite C is obtained by heating Bakelite B to from 160 to 180 deg. C. under air pressure at six to eight atmospheres. Bakelite C is so hard that it cannot be dented by the finger nail and is not plastic even when heated to 300 deg. C. At higher temperatures it will char, burning with difficulty and without flame. Bakelite C forms an excellent insulator for both heat and electricity, and can readily be machined. It is almost as elastic as ivory, so elastic in fact that it serves for making billiard balls. When pure it is transparent and pale yellow in color, but during the process of manufacture it can be colored with alcoholic solutions of aniline dyes.

For the information given we are indebted to the manufacturers.

Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Connecting an Hydraulic Accumulator

Q. We are about to erect an hydraulic accumulator, and we notice that it has connections in its stem for the line to come either from the side above the base or from the bottom of the stem below the base. Please tell us to which we should connect for the best results.

A. Connect your line to the side outlet above the base. You can use the one from the bottom, but this means putting through the foundation a trench which the base will have to bridge. It is a very difficult matter to make and to maintain a tight joint at this bottom connection, and the trench is a miserable place to work in when a leak does occur.

There is also another danger with such an arrangement. The use of water in the hydraulic machines often causes the accumulator to land heavily on the pumping blocks. This throws a severe strain on both base and foundation. We know of a case where a 340-ton accumulator thus caused its foundation to crack through the trench for the bottom connection. The crack was not noticed until, due to edge support only, the base also broke and the accumulator fell over. No one was killed, but a building wall was knocked down, and the loss to production during repairs and re-erection was very serious.

Incidentally, before you set up the stem, see that the bottom outlet is plugged or capped permanently.

Maintenance for Production

Q. I have a force of fifty men on maintenance work, a number that should be ample for the lineup of machines that we operate; yet we have continual trouble with the production department on account of the number of machines down. That no one connected with production seems to have any idea of the time required to make a repair properly, is one main trouble. Another is that many of the machines that we work on are not used for some time after the repairs have been completed, even though we did the work in a hurry. In other words, we unfortunately, often guess wrong as to which machine is actually needed first. We are anxious to serve production to the best advantage, but all that we have to base our lineup of work on is the fact that everything out of commission is needed "at once." I shall appreciate any suggestions you can make.

A. So long as production is anything like normal, the maintenance department will always have work ahead of it. And it seems to be a curious fact that putting on more men only results in finding more things to do, so that the proportion of work ahead is not materially altered.

This "curious" fact, in cases where it does exist, can be explained by saying that there is no definite knowledge of the amount of work that is to be done. The first step is, therefore, to list all of the work ahead. It is not actually difficult to do when a real attempt is made. It can be based on the knowledge of existing troubles held by each of the men in charge of the different divisions of the maintenance work.

The next step is to estimate the time required by each job for either temporary or permanent relief. The estimate should be made by the maintenance foremen to the best of their knowledge and should be set down in terms of man-hours. The totals shown on this first list will probably be rather staggering and, to say the least, enlightening. The best means we know of acquainting the production executives with the extent of the maintenance work, perhaps for the first time, is to show them this complete list.

The third step is to determine, in conformance with the production executive, which jobs shall be done first, second and third; which shall be temporary, and which shall be permanent. The totals of this revised list will automatically show the size and the man-hours of the maintenance force required.

The fourth and final step is to set up in the maintenance department, possibly through the time-keeper, a means for adding new work to the schedule and of cancelling those jobs that have been completed. Each job, as it comes in, should be estimated by the maintenance foreman involved, reported to the production scheduling department and set for performance at the latter department's direction.

There are numerous details that will need working out to fit given conditions of a given business, but in general this plan will certainly eliminate the major causes for the maintenance troubles you are having at present.

The Draftsman and the Shop

Q. One of the draftsmen in my department has suggested that he be allowed to spend an hour of his time each week out in the shop, aside from the time that he now spends on chance errands for one reason or another. He stated that he thought he could do his work at the board to better advantage if he had this time to spend seeing what was going on by way of actual construction on the designs he and the others made. I believe there is merit in what he says and am requesting your opinion of my plan to have each of the twelve draftsmen put an hour a week in the shop in this way.

A. Assuming a working week of 48 hours, you would thus use 12 man-hours per week of your available 576 man-hours for drafting and design. It is our opinion that the comparatively small amount of time actually lost at the drawing board would be returned to you many times over in better design, greater interest and more rapid production of the designs you are working on. Any plan that will let the designer get actual contact with the result of his work will be almost certain to result to everyone's advantage.

Technical Abstracts

Cutting Internal Gears

The present methods for cutting internal gears, excepting the gear shaper method, are inferior to those for cutting external ones. The three chief processes for cutting external wheels are hobbing, generation from a cutter of rack form, and the gear shaper process. The gear shaper process is usually used for cutting internal gears. A hobbing process, making use of a short hob, is sometimes used for internal gears with large numbers of teeth, but it can hardly be called a generating method, since the hob is usually shorter than the length which would be required for effective generation, and consequently the teeth are formed rather than generated.

The gear-shaper process has not yet been applied to larger internal gears which, therefore, must be cut by a forming process, the usual method being either to slot the tooth spaces with a cutter formed to the correct shape, or, where possible, to mill them with a rotary milling cutter. Both these latter methods have a disadvantage in the difficulty of keeping the tool of the correct shape, and the further disadvantage that errors in setting the tool are reflected in the accuracy of the gears. H. Walker in *The Engineer* (England), Feb. 5, p. 146.

Casting Waste

Many metal-cutting machines are rated on their ability to remove stock. The real test of the tool should be its ability to generate the true shape with a minimum of stock removal. Processes of founding leave surfaces which are of a different texture and which have different physical and even chemical properties from the metal within. Usually $\frac{1}{16}$ or $\frac{1}{8}$ in. stock is added to the pattern to get the steel tool below the hard scale. This means that in some cases due to warping of castings it was thought necessary to provide for as much as $\frac{1}{4}$ in. or $\frac{3}{8}$ in. excess metal. With grinding tools this is altogether too much metal to remove. Nevertheless, in many foundries the old pattern tolerances still remain in spite of the change in machine shop methods during the last 10 years or so. This excess finish is a case of pure economic waste which should be avoided. This may mean the adoption of more careful methods of molding in the foundry and perhaps involve a slight increased cost of making castings but will lead to a decrease in the cost of machining. Alan A. Wood, in *The Iron Age*, Feb. 18, p. 487.

Shop Lighting

The prime requisites of a good lighting system embody: first, light of suitable quality; second, light in the proper direction, and third, light in an adequate amount. Bare lamps cause glare, eye strain, wasted light and harsh shadows. Local lights scattered about the shop on drop cords make a type of installation from which there is always danger of accidents, particularly where local lights are suspended on drop cords in and about belting and moving machinery. Robert L. Zahour, of the Westinghouse Lamp Co. in *Industry Illustrated*, Feb., 1926, p. 12.

Simplified Production

In large production and machine tool equipment the number and the arrangement are decided according to a predetermined method or process of manufacture with the idea of having the parts flow continuously from machine to machine without interruption, or accumulation between. In the jobbing shop the tool equipment is segregated in departments, all drills in one place, all lathes in another, and so on. The work is then carried to the grouped tools.

When productive machine tools and equipment are segregated completely, frequently the same piece will be returned several times to a department, say, drilling department, for a succession of holes, each move and operation requiring much handling with a consequent increase in the volume and the value of material on the floor. In other words, an excessive amount of process material may be on trucks being toted about the plant to get to remote departments for some simple operation. H. H. Edge, works manager of the American Type Founders Co., in *Manufacturing Industries*, Feb., 1926, p. 93.

Plant Efficiency

There are various avenues for reducing cost that still remain unexplored in many works. Among these may be mentioned hot brass stampings, die castings, welding processes, the use of pressed sheet metal and so on. In many cases assembly processes still remain crude, and there are a large number of small tools and appliances that in many works still appear to be unknown.

One of the indirect benefits secured by attention to the earlier processes is that of uniformity. This is especially true in the foundry or in drop forging and stamping shops. Castings and forgings should be held to a uniform size, and every care should be exercised that clean and uniform metal is secured. In this way only can sound, reliable castings be delivered to the machine shop and the full benefits of accurate and up-to-date machining processes be secured. Jigging is simplified and savings are effected from the outset. —*The Automobile Engineer* (England), Jan., 1926, p. 1.

Electric Welding

The fusion method of electric butt welding is favored at the welding experiment station of the German State Railways. Electric current is passed between the ends of the two parts to be welded until they are uniformly heated. The ends are then suddenly pressed together and thus joined. Coated electrodes are not recommended for arc welding except for welding overhead or with alternating current. The bare electrode in the hands of a skilled workman is equally protected from oxidation and there is no danger of slag material dropping into the joint. Alternating current gives a very flickering arc and the coating steadies it. This kind of current is cheaper but much less satisfactory in operation. Welding is regarded as being superior to riveting for structural purposes. Councellor Bardtke in *Maschinenbau*, Jan., 1926.

American Machinist

KENNETH H. CONDIT AND FRED H. COLVIN
Editors

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Inspection—Too Much or Too Little

THE question of inspection is viewed from many angles. Some plants have work inspected after every operation, others have no official inspection until the final assembly. This statement cannot, however, be taken at its face value unless we realize that having no official inspectors does not mean that no inspection is made. It is largely a matter of definition.

Whether every piece is tested by an official inspector with a special gage, or whether it will be rejected or accepted by the fixtures of the next operation, it is inspected within the real meaning of the term. The system in one shop is to make each man responsible for detecting an error in the previous operation. If he accepts a piece and works on it he is not paid if a previous operation rendered it unfit for use. But it would not be fair to say that there was no inspection.

Inspection should detect errors as soon as possible after they are made, without delaying production or involving much transport of the material. Unnecessary inspection adds wasteful overhead and can frequently be avoided by securing the interest of the men in the plant and its product. A corps of men who are really interested in their work is an excellent insurance against scrapped material.

An Important Company Representative

FEW people realize how important the purchasing agent is as the representative of his company. Every one understands the importance of having salesmen with attractive personality, good appearance and the ability to make old customers as well as prospective ones think well of them and the company they represent. Salesmen are the advance guards, the outposts of the company and much of the company's good will depends on them.

The purchasing agent, on the contrary, is in the home office. He is constantly under pressure from high powered salesmen of other companies and he naturally grows some kind of a protective shell to resist these numerous attacks. At the same time, he is the representative of the company, and the only one, with whom men from many other companies do business and their opinion of his company is likely to be based on their impression of him. He may see many more men in a day than will the salesmen of his own company and his contacts are correspondingly more numerous.

It is entirely possible so to arrange things that visiting salesmen are kept waiting a minimum length of time and induced to state their business as briefly as possible. Successful purchasing agents are doing it and in so doing are building good will and prestige for their companies. In addition they are helping considerably to reduce economic waste and to lower the cost of selling. Their companies are reaping the benefits in lower prices for the things they have to buy.

Financing Railroad Shop Equipment

WHY should not railroad repair shop equipment purchases be financed in the same way as railroad rolling stock purchases? With very few exceptions rolling stock purchases are financed through equipment trust certificates that are sold to investors. In other words, the railroads buy their rolling stock on the installment plan, paying for it out of its earnings.

As yet no really successful attempt has been made to put shop equipment purchases on the same basis, although it would be quite as logical a proceeding. Apparently there are two objections, more or less psychological in character but hard to remove.

In the first place there is the attitude of the railroad executive himself. He is apt to look upon maintenance equipment as a necessary evil to be acquired in as limited an amount and at as small an expenditure as possible. He cannot see that it will bring him in any money. As a matter of fact, of course, adequate shop equipment would so reduce the maintenance charges on some roads that deficits could be changed into profits.

There is also the attitude of the equipment trust certificate buyer to be considered. As a rule he is not technically acquainted with railroad operation but he does use railroad transportation and every time he buys a ticket or ships goods he gets a clear picture of the railroad car or locomotive as a piece of money making apparatus.

The Equipment used in the maintenance of rolling stock is usually outside of his field of vision. He never thinks of the need for railroad repair shops until a strike interferes with schedules. As a consequence he has never been much interested in investing in anything so nebulous, to him, as shop equipment, or rather, the certificates that represent it.

If the financing of shop equipment on this basis is to be successful it seems evident that something must be done to change the mental attitudes of these two interested parties.

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Olsen-Lundgren Vertical Balancing Machine, No. 3

For balancing flywheels, pulleys, clutch parts, disks and bodies that are easily handled on a vertical spindle, the Tinius Olsen Testing Machine Co., 500 North 12th St., Philadelphia, Pa., has brought out the No. 3 vertical balancing machine illustrated. The principle of operation of this machine, in general, is the same as that of the Olsen-Carwen horizontal type previously described on page 386, Vol. 59, of the *American Machinist*.

An unbalance is created in the machine to counteract the unbalance in the body being tested. When this balance thus created in the machine is of the same magnitude as the unbalance in the body being tested and when the two planes of the unbalance in the test piece and the machine are of opposite directions, the whole unit comes to rest, or is said to be in balance. The amount of the artificial unbalance is registered direct on dials on the machine.

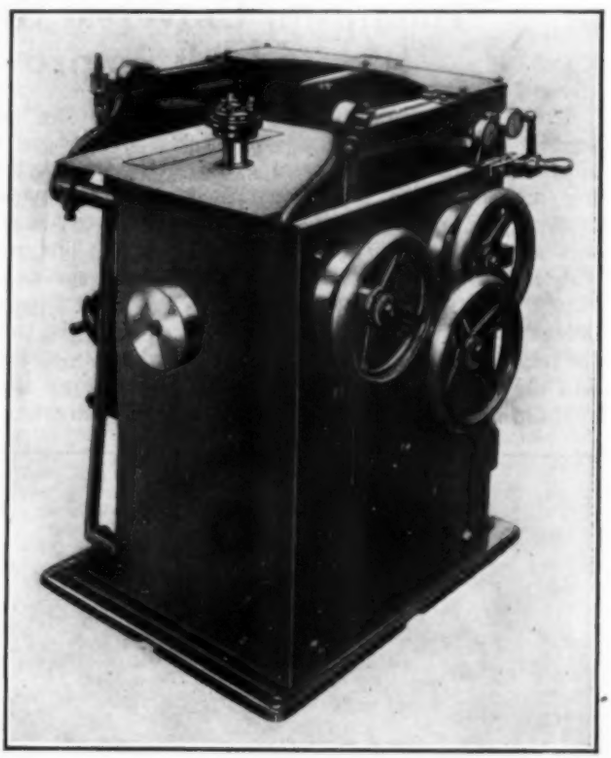
The No. 3 balancing machine will register both static and dynamic unbalance, together with the angle of unbalance and it will also indicate the axial position of the static unbalance. It is claimed that this prevents the introduction of a dynamic couple in correcting for the static unbalance, and in cases where no dynamic unbalance exists, the body may be put in perfect balance by correcting at one point only. The machine will indicate the axial location of the static unbalance and it will also show whether a dynamic couple exists in the body tested before the reading is taken.

The machine is composed of three basic units. The baseplate and the support stand are bolted together as one unit which always remains in a fixed position and acts as a support for all the other parts of the machine. The second unit is the static cradle. It is fastened with two plate hinges or springs to the base unit and is free to vibrate around a vertical axis parallel to the support stand. It acts as an intermediate support for the remaining parts of the machine. By shifting the handlever at the upper right-hand corner, at the front of the machine it can be locked or unlocked from the support stand. The third unit is the dynamic unit and is the machine proper. It consists of a front and a back plate held together with four stay rods. All the indicator dials, the motor and the moving parts are mounted on this unit. It is supported by means of two knife-edge pivots resting on top of the static unit and is free to vibrate around a horizontal axis or plane at right angles to the axis around which the static cradle vibrates. It can be locked or unlocked to the static cradle unit by turning a handwheel.

When the static cradle is locked to the support stand, the dynamic unit is free to vibrate, and when the static cradle is unlocked and free from the support stand of the machine, the static cradle and the dynamic unit are locked together and vibrate as one complete unit around the vertical axis. The upper right-hand wheel at the front of the machine is for the purpose of operating the balancing blocks or of regulating the unbalance to the proper amount required to counteract the unbalance in the piece tested. The upper left-hand wheel changes the angular position of the balancing blocks so that unbalance can be made to act in the opposite plane to the unbalance in the piece tested. The lower center handwheel is for the purpose of raising and lowering the spindle, including the part to be balanced.

Each machine is furnished with one adaptor which screws onto the head and acts as a support and clamping device for the part to be balanced. This is made to any size.

In operation the part to be balanced is placed on the spindle and locked to the adaptor. The dynamic unit is unlocked so that it can vibrate freely and the machine is then started. The spindle can be moved up and down by turning the lower center handwheel, until the vibration stops. The locking lever is then shifted to the static position and the two upper handwheels are adjusted until the indicator dial shows no vibration, at which point the amount of static unbalance can be read. The power can then be shut off and the machine can be turned by hand un-



Olsen-Lundgren Vertical Balancing Machine, No. 3

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til a pointer at the left-hand side is set on the "O" line on the aluminum disk or indicator wheel. An indicator dial on the top at the center of the machine can next be pulled out and it will show the plane and axial location of the point where metal is to be removed.

The amount of static unbalance is registered on the outer edge of the unbalance dial in ounce-inches for the English measurements, and in kilogram-centimeters for the metric system. This represents the weight times the radius. The register of the machine divided by the radius at which the corrections are to be made is equal to the weight of the material to be removed to correct unbalance.

The existence of a dynamic couple is indicated when it is found impossible to get the vibrations to cease at the first or dynamic setting of the machine, at any height or position of the spindle. In this case the spindle can be set at the point where the least vibration exists, which is the best axial location for correcting the static unbalance. The readings can then be taken for dynamic unbalance in the same way as for static unbalance.

It is claimed that an experienced operator can generally tell from the amplitude of the vibrations on the dial indicator the amount of unbalance present in the body to within a fraction of an ounce.

Thompson Universal Grinder 10 x 36-Inch, Improved

The Thompson Grinder Co., Springfield, Ohio, is equipping its 10x36-in. improved universal grinding machine with a self-contained motor drive. The belt-driven model was previously described on page 84, Vol. 45, of the *American Machinist*. Fig. 1 is a front view of the motor-driven machine, and Fig. 2 shows the right-hand side of the grinder and the motor mounting. The cage containing the motor is bolted to the rear of the base, and the belt drive is carried up through a hollow box column. A 3-hp. motor is used to drive the wheel, and a ½-hp. motor is direct connected to drive the headstock. The headstock provides for 5 work speed changes and swivels through a complete circle.

In this machine the grinding wheel is maintained in a fixed position at all times, and the grinding table carrying the work is made adjustable to any desired position relative to the wheel. The machine can be used as a plain grinder for straight or taper work between centers, as a surface, edge, die, or cutter grinder or as an internal grinder. One column of the machine is surrounded by a body casting or outer column that revolves on a bearing on the base. It carries the elevating knee, carriage and table, which may be adjusted thereby to a position at right angles to the spindle at either end, parallel with it or at any intermediate position.

The base is well ribbed and braced and is cast integral with the reservoir which has a settling basin open on top to permit easy access for the removal of settlings. The inner column is of box design and it is rigidly attached to the base on the bottom end to the grinding wheel head on top. It carries the lower bearing for the power feed shaft. The rear column is also of box design and is similarly attached to the base and the grinding wheel head. The outer column has an annular bearing on the base to which it is clamped in any desired location to suit the work. On this outer column is gibbed the knee which supports the carriage and table. When this column is to be rotated, a slight movement of a lever will bring into

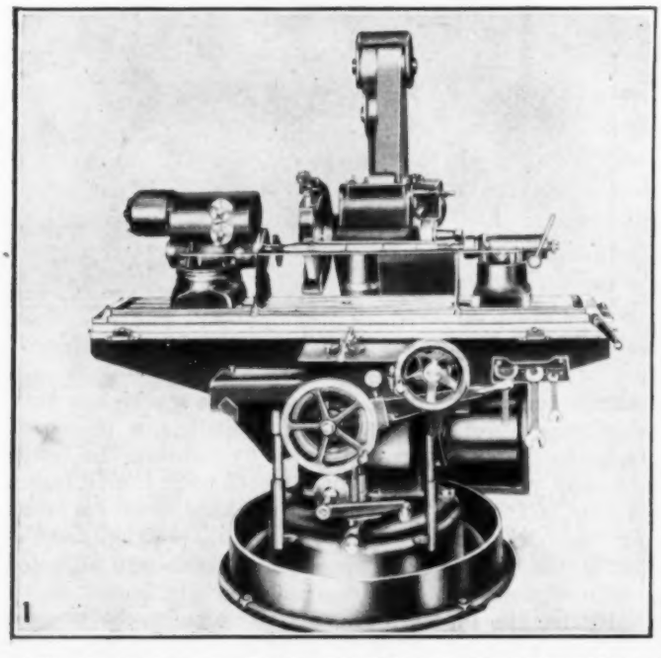

Fig. 1—Thompson Universal Grinder, 10x36-in., Motor-Driven, Improved.

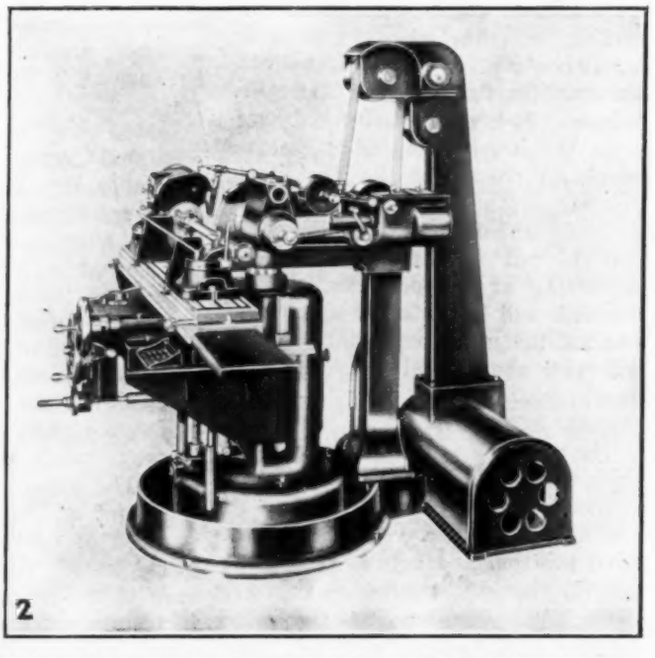

Fig. 2—View of right-hand side showing position of motor

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action a roller bearing which reduces friction to a minimum and greatly facilitates movement.

The knee is of substantial design and is heavily ribbed and braced. The top of the knee is cast solid and forms pockets into which the water drains from the work tables above and from which it is conducted to the reservoir through two large drain pipes. The gears and working parts under the knee are protected from drip and splash by this construction. The carriage carries the work table and operating mechanism, and all guideways are scraped to master plates. The sliding table has a reciprocating motion on the carriage and is controlled by adjustable dogs operating against the reverse lever. The dogs have a fine adjustment to enable grinding against shoulders. The swivel table has its bearing on the sliding table, and is pivoted on a central stud. It can be set at any angle with the ways to allow tapers to be ground without disturbing the alignment of the head and the tailstock centers. It is graduated to read the tapers in inches per foot. Adjustment of the table is made at the right-hand end by means of a worm and rack. Three T-slots are provided.

The headstock swivels on a graduated base with a "V" alignment, and is secured to the swivel table by means of two bolts which slide in the T-slots. It has a hollow spindle fitted at the front end to a Morse taper No. 3. The spindle runs in bronze boxes adjustable for wear, and is also fitted with pulleys for both live and dead center work. The tailstock is secured to the swivel table in the same manner as the headstock. It is provided with a device for supporting the diamond tool holder, so that the wheel can be trued without removing the work. Its spindle is also hollow and fitted with the same taper as the headstock. It is provided with a quick-acting lever and a variable tension spring controlled by means of a handwheel and can be clamped rigidly for supporting the center to the work.

The grinding wheel head which carries the main grinding spindle is a heavy casting bolted to both the inner and the rear column. In the rear end of this head are mounted the change gears for the table speeds and the spiral gears for the pump drive.

The automatic cross-feed is equipped with an action lever on which are mounted two pawls engaging with the ratchet on the handwheel, from which a feed variation of one-quarter thousandth to four thousandths at each reverse is obtained. The ratchet has 250 notches and the screw is of 8 pitch so that the movement from one notch to another advances the work 0.0005 in. When the fine feed is used each pawl advances the ratchet one-half of a notch. The feed is automatically thrown off when the work is reduced to the required size by setting the stop on the ratchet wheel.

The pump is of the centrifugal type, the bearings being above the coolant level, but the runner is immersed at all times, obviating the necessity of priming.

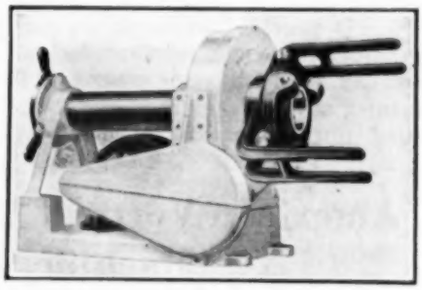
For cylindrical grinding, the machine will accommodate work 10 in. in diam. by 36 in. long between the centers. For surface grinding, it will accommodate work 8x48 in. The grinder can be adjusted for a taper of 3 in. per ft. The hand vertical adjustment of the knee is 10 in. The main grinding spindle rotates at 1,920 r.p.m., and the countershaft at 420 r.p.m. The floor space required is 10x10 ft. and the height of the machine is 6 ft. and 4 in. Its weight is about 3,800 pounds.

Oster Power Pipe Threader, Portable

A lighter weight portable power drive for pipe tools has been added to its line by the Oster Manufacturing Co., Cleveland, Ohio. The body of the machine, which is illustrated, is made principally from aluminum alloy.

The unit is intended for driving die stocks and pipe cutters up to 2 in. in size but, with an auxiliary drive shaft, geared die stocks and cutters up to 6 in. can be accommodated. The machine can also be used to screw up fittings since a pipe wrench can be held in its driving arms. The pipe is held stationary by means of a three-jawed, self-centering chuck and the pipe tools are turned by means of driving arms. Self-centering universal guides in the rear of the machine facilitate in the centering of long lengths of pipe.

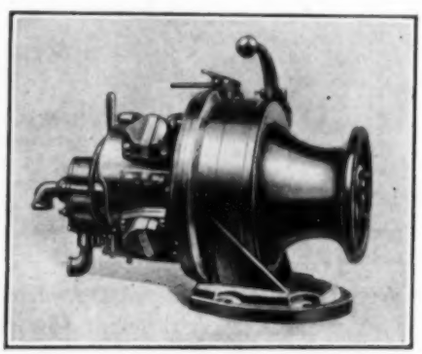
The driving power is furnished from a ½-hp. universal reversing motor, which automatically speeds up on the smaller sizes of pipe and holds the necessary speed on the larger sizes. The motor can be operated on a lamp circuit of 110 or 115 volts, d.c. or 25- to 60-cycle a.c. current. The machine stands 18½ in. high, 14½ in. wide and 30⅛ in. long. Its weight is 150 pounds.



Oster Power Pipe Threader, Portable

Ingersoll-Rand "Utility" Air-Motor Hoist, DU

The size DU, "Utility" air-motor hoist, illustrated, has been placed on the market by the Ingersoll-Rand Co., 11 Broadway, New York, N. Y. The hoist is especially designed for use with portable compressors and is suitable for a wide variety of work. It is provided with mountings by which it can be attached to the rear end of a 5½x5 or 5x5 portable compressor, to the side of larger compressors, or to compressors mounted on Ford trucks.



Ingersoll-Rand "Utility" Air-Motor Hoist, DU

The hoist as illustrated is provided with a winch head but a drum can be substituted instead. The hoist is equipped with a clutch so that

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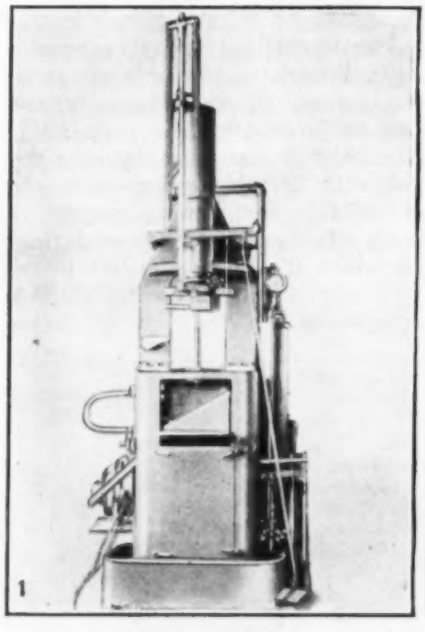
the cable can be easily played out by hand or by a down-grade load without turning over the motor and consuming air. A hand brake on the drum is provided to check the unwinding and to stop it in any desired position. The throttle control will furnish any speed of rope travel desired up to a maximum speed of 65 ft. per min. under average loads.

The capacity of the hoist is for a load of 1,000 lb. Its rope speed under full load at 80 lb. air pressure is 61 ft. per min. The drum head will carry 350 ft. of ⅝-in. rope. The size of the hoist is 15 in. wide, 25⅝ in. long and 19¼ in. high. Its weight is 250 pounds.

American Vertical Hydraulic Broaching Machine, Pull-Type

The pull-type vertical hydraulic broaching machine shown in Figs. 1 and 2 has been added to its line of similar equipment by the American Broach & Machine Co., Ann Arbor, Mich. Fig. 1 is a front view of the machine at its work-discharge position. When the machine is in the loading position, the end of a shank projects through the angular table. The work can be dropped over the shank of the broach and from this point the broach is raised until it connects automatically with the pull head.



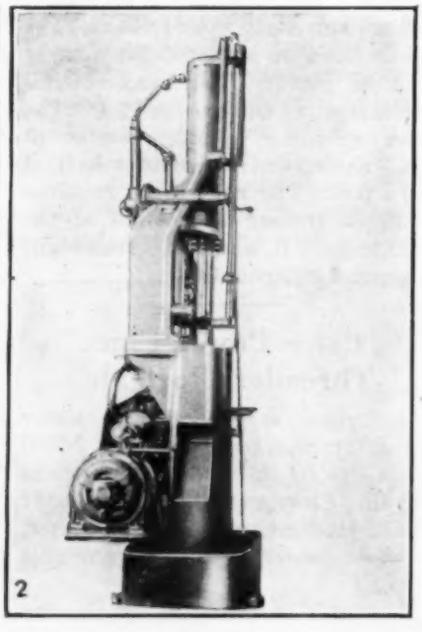


Fig. 1—American Vertical Hydraulic Broaching Machine, Pull-Type.
Fig. 2—View of the left side of the machine

The initial movement of the broach is secured by means of a lower hydraulic cylinder controlled by means of the outer of the two pedals which can be seen at the right of the machine. When the broach connects with the pull head, the operator turns the foot slightly, pressing a second pedal which starts the pulling ram. When the broach has reached the position shown in Fig. 2, the work is dropped onto the angular table and slides down the chute at the left.

A knock-off stop trips the controlling lever to automatically return the machine to a point at about 5 in. from the bottom of the stroke. At this point the head automatically releases the broach by means of a latch attached to the left-hand vertical member of the frame. The broach then drops through a distance of about 5 in., passing through a soft metal guide in the angular table and into a soft metal bushing in the upper end of the lower cylinder. This 5-in. drop is said to effectually shake off all chips from the broach. In addition to the pedals, hand-control levers are provided which can be used when desired.

The machine is equipped with a pump supplying a cutting lubricant and pumping a flood of oil just underneath the angular table. The front of the column is provided with a sheet-metal splash shield. The hydraulic pump used on this machine is similar in design to that described in connection with the type V-18 broaching press on page 179, Vol. 64, of the *American Machinist.*

The machine will accommodate broaches up to 18 in. in overall length, and is suitable for such operations as the sizing of round holes, sizing of spline holes and the broaching of hexagon serrated and other shaped holes. The machine is furnished complete with a full flow, twin-screw type constant-pressure pump and supply tank. A 5-hp. 1,800-r.p.m. motor is recommended. The press requires a floor space of about 5 sq.ft. and it weighs approximately 3,400 pounds.

John B. Stevens, Inc., Purchases Garvin Milling Machines

The entire line of milling machines and milling machine attachments formerly manufactured by the Garvin Machine Co., has been purchased by John B. Stevens, Inc., 27 Cleveland Place, New York, N. Y.

Production has been begun once again on the more important items of the line which is an addition to several Garvin lines of equipment taken over by this company.

Sees Big Market in South America

E. J. Gittins, vice-president of the J. I. Case Threshing Machine Co., of Racine, Wis., one manufacturer of agricultural machinery, returned last week from a three-months' trip to South America, having visited especially all the agricultural sections in Argentina and Chile. Mr. Gittins states that exports to South America of modern agricultural machinery are bound to increase greatly in the future, the American product being especially well adapted to the requirements of the South American agriculturists. He said that farmers were taking a big interest in tractors and American machinery.

News of the Week

Stabilizing Business Formed Keynote of Management Convention in New York

Financial and office executives, production and operating executives and sales executives meet in separate groups

For three days, March 3, 4 and 5, members of the American Management Association discussed means of stabilizing business at their annual convention in New York. Four general sessions were held and a number of group meetings.

Speaking at the opening of the first meeting, President S. A. Lewisohn described the association as the national clearing house for management methods and information. He was followed by John A. Garvey of the Dennison Manufacturing Co. and Dr. Max Freyd of the Personnel Research Federation, both of whom discussed the theory and practical use of rating scales for employees. The three groups of financial, production and sales executives, then broke up and each discussed rating methods for its particular type of worker.

At the general session in the afternoon, John A. Stevenson, vice-president, of the Equitable Life Assurance Society, gave his views on the line executive's part in training. He pointed out that it is almost impossible to learn any job by reading about it; that it is necessary to work under actual conditions to learn how to meet all the difficulties involved. The line executive is therefore the man on whom final training of subordinates devolves. He must be thoroughly in accord with the training plans and actively assist the functional training executive in performance.

At the group meeting for production executives that followed, Frank Cushman, of the Federal Board for Vocational Education, spoke of the foreman's part in training. He pointed out the fatal error of training men as foremen where no vacancies existed to which they could be promoted, and said that it is hard for uneducated men to apply fundamental principles to actual cases. It is better to work out the principles from the everyday practice. The specialized knowledge possessed by foremen and operators of the tools under their immediate control is what keeps a shop running smoothly.

At the Thursday group meeting of operating and production executives the subject was "Planning and Maintaining a Regular Flow of Work and Employment." Several of the speakers were unable to be present. Of those that did appear, Chas. S. Redding of the Leeds and Northrup Co. had the most interesting message for machine shop operators. His company makes extensive use of research to develop products and widen sales fields. It also has an unemployment insurance fund that provides payments for men with dependents running at the rate of 75 per cent of their weekly wage, from 3 weeks for men three months with the company to 26 weeks for those with 5 years service. The fund is raised by setting aside each week an amount equal to 2 per cent of the weekly payroll until the sum equals twice the total weekly payroll. This is believed sufficiently for all requirements. Single men share on a 50 per cent basis. The company has been successful in working overtime when business is good rather than increasing the force.

Under the title of "What's Ahead for Management" Mrs. Lillian Gilbreth made an address that was full of suggestions for managers in all industries. She pointed out the similarity of management problems in all industries; the need for a free interchange of experiences; the futility of secrecy and the need for the lessening of both waste and fatigue in industry and in the home. Fact finding investigation is of great value, but research, with a vision as to the future, is necessary for real progress.

The executives for the coming year are: Sam. A. Lewisohn, chairman of the board; Frank L. Sweetser, president; H. B. Bergen, treasurer; Ernest G. Draper, vice president, Financial Executives Division; Sterling B. Cramer, vice-president, Office Executives Division; Frank P. Cox, vice-president, Production Executives Division; R. B. Flershem, vice-president, Sales Executive Division and C. S. Ching, vice-president at large. W. J. Donald continues as Managing Director and Secretary.

Chicago Section of A.S.M.E. Will Hold Symposium on Wastes in the Machine Shop

Prominent engineers to discuss subject

Last year the Chicago Section of the American Society of Mechanical Engineers devoted a special meeting with afternoon and evening sessions to machine shop practice. This was in response to repeated requests from the membership that more attention be given this field. The initial attempt met with good response so that a similar effort is being made this season and it is quite probable that machine shop pracitce will become one of the leading features of the standardized seasonal program of the section.

This year it was considered that there could be no more timely subject than a symposium on wastes in the machine shop. There will be afternoon and evening sessions with five papers in all devoted to some phase of this general subject. The date is March 24, and the meeting place, the rooms of the Western Society of Engineers in the Monadnock Building, Chicago. To make the meeting more representative, the mechanical section of the Western Society of Engineers will participate jointly with the Chicago section of the American Society of Mechanical Engineers.

At the afternoon session, starting at 2 p.m., three papers will be presented. The first two papers will deal with the general topic — "Tool Manufacture versus Tool Making." In one of these papers G. A. Pennock, technical superintendent of the Hawthorne Works of the Western Electric Co., will discuss the "Division of Labor in Tool Making," between a number of experts as opposed to the old method of having one man follow the job through. The second paper will deal with the other angle of the problem, that of the "Selection of Tool Steels." The author will be J. B. Mudge, a metallurgist. In this paper reference will be made to methods of heat-treatment, microscopic studies and other factors having a bearing on the selection of the steel. The third paper of the afternoon session will deal with "Maintenance and Upkeep," which will be discussed by George Hodge, of the industrial relations department, the International Harvester Co.

"Managerial Wastes in Machine Shops" by Hugo Diemer, of the La Salle Extension University, will be the opening paper of the evening session. It will be recalled that the report of the Hoover Commission on Waste in Industry showed that of the 28 per cent of preventable wastes in the machine shop, 81 per cent was due to management. Colonel Diemer will tell where the management is at fault.

"Reclamation of Processed Material" is the topic of the final paper of the meeting. Along this line the railways perhaps have done more than many of the industries, and of the railways, the Santa Fe has been particularly active. One of its engineers will give the details on converting salvage material into a higher grade product before disposing of it, or re-using it.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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THE New York markets all danced to the music of the Stock Exchange last week, but it is doubtful whether business throughout the country has yet been seriously affected by the collapse of the speculative structure that had been reared in Wall Street.

If merchants will but recollect that the wealth of the nation consists of consumable things and that their number and intrinsic value has not been reduced because stocks are quoted lower, the commercial depression that some are now predicting may be averted.

The daily papers have published such full reports of the collapse in security value that it is unnecessary to describe it in detail. The Interstate Commerce Commission has refused to authorize the Van Sweringen consolidation of railway properties valued at over a billion dollars, because the terms and conditions under which it was proposed to effect the merger were not just and reasonable to the shareholders in some of the properties. But the commission admits that from a transportation standpoint the proposed combination is desirable, and there is some reason to believe that it may be reattempted along lines that will be more equitable in so far as the stockholders in the component companies are concerned.

But the railroad stocks affected are not the only securities that are lower. Many of the speculative favorites that had been over-bulled during the recent rise were carried down before and after the Interstate Commerce Commission exploded its bomb, and the present disposition is to assume that the so-called Coolidge boom is ended, at least for the present. No one can say whether this is the case, but it is plain that the stock market is still groggy and that it will take time for it to recover its vigor and resiliency.

A different feeling is, however, already discernible in the commodity markets. Sagacious merchants had watched the boom on the Stock Exchange with apprehension. They knew that the psychological effect of its collapse would be a shock to general business, and they were in consequence deterred from stocking up. Now that the shock has passed and been absorbed, they feel justified in going ahead with confidence. The result is that while the stock market is still somewhat unsettled, an improved demand for staple merchandise has commenced to make itself felt, and wheat, corn, and cotton all show substantial recoveries.

Prominent business men interviewed by the writer at the end of the week seem to feel that the outlook has been decidedly improved by the liquidation that has taken place in the security markets, and while they admit that there may be some curtailment in demand for luxuries they look forward to spring and summer with serenity.

But many of them are still of the opinion that a curtailment in new and unnecessary building as well as in real estate speculation must be had before the business of the country completely recovers its poise. The feeling that this curtailment is overdue and the fear that it may cause a secondary spell of weakness in some quarters, operates as a deterrent in the localities where the land and building boomers have been at work.

What's Doing in Industry

With the exception of one or two localities in which machinery business has slowed up perceptibly, the rest of the country seems to be enjoying a steady volume of trade. True, conditions are spotty, and orders are scattered and represent in nearly all cases single machines, but the general tone of the market is better at this time of the year than it was a year ago.

Detroit sales are steady, automotive people buying regularly of special types and employment in the shops reaching its highest limits. Cincinnati reports an increase in activity this month, new inquiries forecasting more business. In Chicago new business is divided among electrical and farm implement manufacturers. Indianapolis shows a slight improvement, steel fabricating plants being in the market for equipment.

Trade is brisk in Buffalo, industrial construction giving impetus to sales of machinery. The New England territory reports an increase in export business, and in Canada conditions are favorable for additional buying by railroads and power companies. New York trade is slow, little being done in the way of new sales programs.

The flurry of buying and selling that seized the stock market last week has not had any appreciable effect on general business conditions. The intrinsic value of commodities has not been reduced because stocks were quoted lower, and a commercial depression seems highly improbable.

The outlook is otherwise sound and probably healthier than it has been for some time. Secretary Mellon, for whose financial judgment the country has great respect, is quoted as saying that the decline in the stock market will have a wholesome effect and that fundamental business conditions and prosperity will not be disturbed.

To the observer who looks below the surface of the week's agitated markets, the most impressive feature was the absolute equanimity of the money market despite the turbulence of the Stock Exchange. For this we have the Federal Reserve System to thank. The statement that it has made a money panic impossible seems to have been corroborated by the week's developments, and for the shock absorber so provided all business men ought to be profoundly grateful.

The automobile people are said to be going ahead on full production schedules, but some curtailment in that industry is possible. Steel, if anything, is better and tin has advanced sharply, but the other metals have not fluctuated abnormally. On the new rubber exchange the market has fluctuated in an erratic fashion, but around 50 cents there seems to be a fair demand.

The tendency toward centralization by consolidation is still noticeable. The Franklin National Bank and the Fourth Street National Bank of Philadelphia are to be combined. The Mercantile State Bank of Minneapolis and the Northwestern National Bank of the same city also have been consolidated. The National City Bank of New York has bought the Peoples Trust Co., of Brooklyn. The Standard Fruit Co., with a capital of $50,000,000 has been organized at New Orleans to take over the business of the Standard Fruit and Steamship Co., the Mexican-American Fruit and Steamship Co., the Bragman's Bluff Lumber Co., and other interests of the Vaccaro family. The first Federal Foreign Investment Trust is being formed with a capital of $5,000,000 to deal in foreign securities.

It is estimated that the revenue of the French government will show a deficit of 100,000,000 francs during March, but the passage of a bill that will increase taxes is confidently predicted. This prediction has prevented any further decline in the franc.

In the British Empire trade appears to be improving, and emphasis is still laid upon the extraordinary prosperity of East India. The world view is reassuring, and unless America again becomes the victim of its own enthusiasm the United States should share in the prosperity that seems to be indicated.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Milwaukee

The tone of business in metal-working equipment remains encouraging, despite developments that under ordinary circumstances might arouse a feeling of more or less apprehension. The business of foundries and machine shops appears to be quite too substantial to be materially affected by relatively superficial disturbances, and new orders continued to be received.

Manufacturers of machine tools encounter no difficulty in keeping their order books in a comfortable state with relation to production, and this is being maintained at a rate at least equal, and in many instances above the level of the last four months. On a broad average, automobile shops are furnishing a good volume of business, to which is now being added new requirements of many other lines of industry.

Cincinnati

Increased activity since the first of March is reported by Cincinnati machinery manufacturers and selling agents. There is a common feeling that market conditions are getting better and an increased demand is expected during the next few months.

The greater part of the buying in the past week was of a general nature, the purchases having been made by a diversified line of users. Orders and inquiries were well scattered over the country, the greater part of the demand being for single tools. An increased number of purchases were for try-out purposes.

Many inquiries were received from railroads in the past week, but the amount of buying done was by no means large. There was a good demand from the automotive industries, and the increased number of inquiries are regarded as an indication of a quick revival of this market.

More sales were made to the electrical industry, which also is sending in an increased number of requests for quotations.

Detroit

Sales of machinery and machine tools in Detroit and southeastern Michigan during the first two months of 1926 were far above those for January and February, 1925, and the market conditions as shown so far in March indicate that the first quarter of the year will show a substantial increase over the same quarter in 1925. There is a general demand for both machinery and tools, with very little call for used tools. The market for used tools is no as brisk as it was some weeks ago but this condition may be changed at any time.

The present demand is for general equipment, with milling machines, grinders, lathes and hoppers at the top of the list. The drift which has been going on gradually for the past year away from grinding and more to lapping of cylinders is continuing. One or two firms which still grind cylinders are reported to be on the eve of change which will bring their operation into the lapping field.

Packard at present is the most active of plants as far as the machine tool dealers are concerned. During the past few weeks new equipment has been installed all along the line. In some cases the equipment has been cut by one-half, while production has been increased, all due to the installation of new machinery which is up to date. Contracts for 150 airplane engines at a cost of $2,364,000 have been placed with the Packard Motor Car Co., by the Navy Department, and extensive purchases are expected by machinery manufacturers.

Employment in Detroit has broken all previous marks, the Detroit Employers Association reporting 270,395 men at work in the city's factories, an increase of 1,609 over the previous high water mark of all time in Detroit.

Indianapolis

Demand continues to show slight improvement in this territory both in tools and machinery, with every prospect of a better spring than last year. Most of the tool demand continues to come from the automobile industry. Two of the largest factories here are working very nearly to capacity and are behind with their orders. Some tool demand is coming from the fabricating plants where business is picking up

Some machinery demand is coming from the railroads, but the requirements for this state are rather light. A good demand is noted from furniture factories.

Demand for special machinery for flour mills is good, many mills making replacements and others adding to plants and installing new machinery. Public utilities are buying some machinery, as are car plants in this state. Second-hand machinery is moving only fairly well.

Chicago

While a slight falling off in sales of machine tools during the last days of February was noted, business for the month, as a whole, was decidedly satisfactory to dealers. The increase over January sales in most instances exceeded expectations.

Inquiries are being received in such numbers and of so varied a character as to warrant the forecast of machinery men that March will prove better than February. Not only railroads, but several large manufacturers are in the market for machine tools and special machinery. With the exception of the Northwestern, which has closed its list, other roads have not yet indicated that they are nearly ready to close.

The present demand is coming largely from electrical manufacturing concerns, automobile and auto truck manufacturers, and farm machinery makers. The call for used machine tools is chiefly for punch presses, grinders, millers, lathes and spindle drills.

Canada

Industrial conditions in Canada continue to shape up favorably for the machine tool trade. With many new projects announced in the past month and railroad buying being done on an extensive scale, dealers are quite confident that sales will increase.

The Canadian National Railway will spend approximately $6,000,000 on the construction of branch lines this year.

Two important announcements concerning the pulp and paper industry are that a $2,000,000 paper mill is to be constructed on Poplar Island, British Columbia, by American and Canadian capital, and that the International Paper Co. has placed an order with the Canadian Westinghouse Co. for equipment valued at $1,250,000 for the new power plant at Chelsea, Quebec. What is stated to be one of the largest orders for structural steel ever let in Canada has been placed with the Dominion Bridge Co., by the Aluminum Corporation, whose large plants are being constructed on the Saguenay river, Province of Quebec.

New England

A better demand for machinery is reported by manufacturers in the Connecticut section of New England. The buying is for the most part from sources indicating export trade, with Italy and Germany represented as the best buyers. There is a good demand for automatic machinery from the Middle-West territory. Most of the domestic buying appears to be of the hand-to-mouth order and in the week there was a slight falling off in the volume of inquiries.

Small tools are in good demand and manufacturers are encouraged by the volume of business in process of manufacture and booked for early shipment.

A better demand for chucks and dies, especially in foreign markets, is observed.

Buffalo

The machine tool trade continues brisk in Buffalo with a predominance of small orders making a good volume. In the final figures February will probbaly show up much better than last year.

The Allis-Chalmers Manufacturing Co. was reported as landing the engineering contract for the Federal Portland cement plant to be constructed in Buffalo this spring. It is reported that a plant equally as large, representing a total investment of more than $1,000,000, will also be built by the Great Lakes Portland Cement Co., and bids are now being received for its equipment.

The demand for contractors' equipment is slow. There is little or no activity in railroads.

Demands for electrical equipment are keeping pace with that for machine tools. Most dealers cannot see anything but good business in the immediate future.

New York

The local market has struck a calm. For the past week sales have been slow, inquiries have dropped off and general business activity in the machine tool and machinery trades has been only fair. However, some very good prospects are in evidence, airplane manufacturers and large industrialists showing signs of awakening interest in some of the newer types of machine shop equipment.

Business in small tools, mill supplies, miscellaneous machinery and builders' hardware is good. Hand-to-mouth buying still persists in these lines.

The International Motor Co., the Otis Elevator Co., the General Electric Co. and the New York Central R.R. are mentioned as expectant buyers.

Orders placed in the past ten days include: 5 spline millers, 3 hand millers, 2 automatic lathes, 3 geared-head lathes, 4 vertical surface grinders, a 42-in. boring mill, 2 automatic worm grinders, 2 radial drills and 2 breaking machines.

Personals

C. T. CHAPMAN has been transferred from the Scranton, Pa., office to the Cleveland office of the Ingersoll-Rand Co.

J. E. MOSS, of Wheeling, W. Va., has been elected president of the Massillon Steel Joist Co., of Canton, Ohio.

AXEL MALM has been appointed chief of machinery for the Sesqui-Centennial Exposition in Philadelphia.

HENRY G. WEAVER, of the General Motors Co., Detroit, has been awarded the 1925 Harvard Award for scientific research in advertising.

ALFRED KAUFFMAN, president of the Link Belt Co., has been made an honorary member of the Indianapolis Community Fund for 1926.

E. M. IVENS has resigned as representative for the Ingersoll-Rand Co. in New Orleans, and is now special agent for the Chicago Pneumatic Tool Co. in that city.

HARRISON COLLISTER has been transferred from Cleveland to the New York office of the Warner & Swasey Co. He will assist Eugene Gardner in covering the Eastern territory.

WARREN D. BLATZ, general sales manager of the Bridgeport Brass Co., Bridgeport, Conn., and WALTER R. CLARK, general works manager, were recently appointed members of the board of directors.

RAYMOND H. SULLIVAN, vice-president and general manager of the North & Judd Manufacturing Co., New Britain, Conn., has severed his connection with that company, and has been succeeded by Michael O'Hayer.

G. G. MILLS, formerly manager and vice-president of the Riley Engineering and Supply Co., has been appointed to succeed the late William McKay as Toronto manager of the Babcock-Wilcox Co. and the Goldie-McCulloch Co., Ltd.

E. ALLEN MOORE, chairman of the executive committee of the New Britain Machine Co., New Britain, Conn., has retired from the board of directors, and will be succeeded as chairman of the executive committee by John H. Goss, of Waterbury.

A. S. ANDERSON, formerly secretary of the Terre Haute Malleable Manufacturing Co., has been elected president of the Standard Malleable Casting Co., of Terre Haute, Ind. E. D. Halsey, production superintendent of the Terre Haute Malleable company, has been appointed to succeed Mr. Anderson.

Obituaries

JOHN T. EWING, engineer of tests for the Chesapeake & Ohio Ry., died at Richmond, Va., on March 4.

STANLEY MCFADDIN, formerly Western representative for Henry Prentiss & Co., of New York, died in Cincinnati on March 2.

JOHN HENNEY, former master mechanic for the New Haven R.R., died in New Haven on Feb. 27.

THOMAS G. WHALING, vice-president of the Westinghouse Lamp Co. and prominent in the engineering profession, died suddenly in New York City on March 1.

WILLIAM J. TOLLERTON, general superintendent of motive power for the Rock Island Railway System, died at his home in Beverly Hills, near Chicago, on March 3. He was at one time chairman of the mechanical division of the American Railway Association.

FELIX A. JACOBS, retired capitalist and one of the organizers of the Kilbourne & Jacobs Co., of Columbus, died at his home recently. He organized the Jacobs Bros. Co. about 45 years ago and this was later changed to the Kilbourne & Jacobs Co., manufacturing agricultural machinery and later cars and heavy hoisting equipment.

Machinery Exports Still Increasing

Exports of metal-working machinery for January, with revised comparative figures for January, 1924, as compiled by the Department of Commerce, are as follows:

	January	
	1925 Value	1926 Value
Lathes	$87,753	.....
Boring and drilling machine tools	64,466	.....
Planers, shapers and slotters	79,055	.....
Bending and power presses	57,470	.....
Gear cutting machines	60,520	.....
Milling machines	129,582	.....
Punching and shearing machines	17,276	.....
Power hammers	12,732	.....
Other metal working machinery and parts of	382,169	.....
Engine lathes	.....	$106,461
Turret lathes	.....	2,423
Other lathes	.....	96,176
Vertical boring mills and chucking machines	.....	6,139
Thread cutting and automatic screw machines	64,748	54,908
Knee and column type milling machines	.....	28,291
Other milling machines	.....	53,045
Disc type gear cutting machines	.....	120
Other gear cutting machines	.....	15,263
Vertical drilling machines	.....	17,499
Radial drilling machines	.....	3,000
Sensitive drilling machines	.....	1,461
Other drilling machines	.....	24,828
Metal sawing and cutting-off machines	.....	14,035
Shapers and slotters	.....	25,309
Planers	.....	1,203
Internal cylinderical grinding machines	125,021	53,726
Internal grinding machines	11,177	68,581
Metal-working tool sharpening machines	.....	32,259
Other metal grinding machines	38,237	29,587
Sheet metal-working machines	.....	61,496
Plate metal-working machines	.....	5,306
Rod or wire-working machines	.....	8,783
Forging machinery	.....	61,578
Rolling mill machinery	.....	38,707
Foundry and molding equipment	51,246	42,695
Other power-driven metal-working machinery and parts	.....	360,231
Other metal-working machinery (total)	270,291	449,307
Hand or foot operated metal-working machinery and parts	.....	13,040
Pneumatic portable tools	76,050	145,761
Other portable metal-working machines	.....	11,454
Chucks for machine tools	21,485	20,702
Reamers, cutters, drills, taps, dies and other metal working tools	172,756	258,350
	$1,722,034	$2,111,724

News of the Automotive Industry

Slackness in demand for Ford cars is the key to the 1926 motor situation. These cars have always been the currency of the automobile world.

But during the last few months Ford cars as motor currency have been inflated. So great have been the offerings of Ford cars in trade that dealers and finance companies alike have been overloaded. Their value has fallen as the supply has increased.

It is no secret that Ford cars have been produced faster than they have been selling. Some motor people declare production has been 5,000 a day against sales of 3,000. Of course much of this surplus production is normal during the winter. Ford could not hope to supply his trade during April, May and June if he did not manufacture ahead. But whereas in past years the Ford dealers and second-hand dealers generally have been able to move their trade-ins rapidly, this year the trade-ins have lagged.

The Ford company of course will lose profits temporarily, though nobody expects it will permit this condition to continue very long. The recent price cut has stimulated Ford sales. It will shortly be followed, however, by a price cut by one of Ford's chief competitors (not a four-cylinder producer). This probably will re-establish the price differential which existed during most of the winter.

The above analysis appeared in a recent issue of the *Wall Street Journal*.

Automobile exports during the first month of 1926 exceeded those of January, 1925, by 8,830 units, or over 50 per cent, according to the automotive division of the Department of Commerce. The total value of all automotive exports during the month under review was $26,860,359, only 19 per cent below the value of the December exports which reached $33,041,755 and which made December the peak month of 1925 for such shipments.

Retail sales of Oldsmobiles from Jan. 1 to Feb. 15 have been nearly four times as great as during same period last year. On Feb. 15 unfilled orders with immediate shipping instructions on file in Lansing exceeded scheduled production for the remainder of month.

The Hupp Motor Car Corporation has produced 12,000 six-cylinder cars introduced late last year. The company is oversold on the new eight although rapidly approaching capacity output on that model.

The Paige-Detroit Motor Car Co. produced 5,485 Paige and Jewett cars in February compared with 3,578 in February last year. Schedule for March is 8,700 cars. Paige cars in February totaled 2,000 against 338 in February last year.

With production maintained at 1,500 vehicles a day, Dodge Brothers have just put into service two newly completed loading docks, which increases facilities for loading outbound shipments.

Business Items

H. B. Kendall & Co., of Detroit, have been appointed sales agents in that territory for the Latrobe Tool Co., of Latrobe, Pa.

The Seifreat-Elstad Machinery Co., of Dayton, Columbus and Cincinnati, has been appointed sales representative in those cities for the Rockford Tool Co.

The Casler offset boring head originally developed by the Marvin & Casler Co., and lately marketed by the Production Engineering Corporation, is now being handled by Herman Casler.

The Cleveland Duplex Machinery Co., of Cleveland, has been appointed exclusive dealer in that territory for Rockford millers and Sundstrand lathes, manufactured by the Rockford Milling Machine Co., of Rockford, Ill.

The Yellow Cab Co., of Baltimore, W. W. Cloud, president, has acquired the plant of the Detrick & Harvey Machine Co., at 508 E. Preston St., and will remodel the buildings for use as a repair shop, service station and garage.

The Hemco Electrical Manufacturing Co Long Island City, N. Y., manufacturer of Bakelite products, heat appliance and attachment plugs, has acquired a plant in Bridgeport, Conn., and will move its entire Long Island City business to the new location.

E. C. Atkins & Co., of Indianapolis, celebrated their seventieth anniversary in business on Feb. 20 with a banquet in the Hotel Severin, Indianapolis. The dinner was under the auspices of the "Atkins Pioneers," members of which have been twenty years or more in the employ of the company.

The Chamberlain Machine Works lost its suit for the recovery of a claim against the United States, for machining shells during the war, when the Supreme Court on March 1 rendered an opinion sustaining the action of the Court of Claims in dismissing the claim. The opinion states that the company was given $41,000 by the Secretary of War and had signed a release. Later, it sued in the Court of Claims, alleging the release was secured through fraud and coercion.

The Black & Decker Manufacturing Co., of Towson, N. D., manufacturer of portable electric tools, announces the acquisition of the plant, patents and properties of the Marschke Manufacturing Co., of Indianapolis. The Marschke company has been building a line of electric grinders, swing grinders, roll radius grinders, snaggers and buffers. The Marschke plant will continue under the supervision of F. W. and W. A. Marschke, founders of the business, in collaboration with the Black & Decker engineering department. The Marschke line of grinders will be sold through jobbers by the present Black & Decker organization and will be sold under exactly the same policies as are the Black & Decker portable electric tools.

Trade Catalogs

Belting. J. E. Rhodes & Sons, 35 North Sixth St., Philadelphia, Pa. A sixteen-page, 3¼x6-in. booklet has been published to describe various installations of Rhodes "Watershed Tannate" belting. Illustrations are included in the booklet.

Boring Machines. The R. Y. Ferner Co., Investment Bldg., Washington, D. C., is distributing catalog No. 420 on the Société Genevoise d'Instruments de Physique high-precision locating and jig boring machines, Model Nos. 4, 5 and 6. The catalog contains twenty-eight, 5½x8½-in. pages that are attractively prepared.

The purpose and function of the machines is first considered, as well as the range of work on which they can be used. The description of the machines is quite thorough and well illustrated.

The use of the accessories supplied with the machine is systematically taken up. Each device is illustrated in its working position so that its construction and operation can be well understood. Tables at the end of the catalog give the complete specifications for each of three sizes of machines.

Cork Foundations. The Korfund Co., 11 Waverly Place, New York, N. Y. "How to Isolate Machine Vibrations" is the title of an eleven-page discussion of the various methods for the isolation of vibration. It describes the advantages and disadvantages of each method and contains a description of the "Korfund" foundation that is well illustrated with both photographs and line drawings.

Electrical Equipment. The General Electric Co., Schenectady, N. Y., has published a 62-page, 8x10½-in. booklet entitled "Some Developments in the Electrical Industry During 1925." This was prepared by John Liston of the General Electric Co., and is reprinted from the *General Electric Review* The book covers the developments in the various departments of industry in an interesting manner and each page contains illustrations of some of the equipment manufactured by the company and in actual service.

Some of the developments covered, in addition to the usual ones in connection with electrical fixtures and apparatus, are gas-electric buses, gas-electric and oil-electric cars and locomotives, electrically driven dredges, ferryboats and freight ships as well as special lighting problems.

Heat-Treating Equipment. Bulletin No. 2602 has been published by the Stanley P. Rockwell Co., Hartford, Conn., and is entitled the "Volcrit Method of Heat-Treatment by the Rockwell Dilatometer." The bulletin discusses the process of "dilatation," the respective merits of the pyrometer and the dilatometer, dilatation curves and the application of the dilatometer.

Lathes. The Watson Manufacturing Co., 2465 Albion St., Toledo, Ohio, has published a circular on its line of "Baby Grand" lathes for wood and metal working. It is composed principally of letters and photographs from users of the various types.

Magnets. The Electric Controller & Manufacturing Co., 2700 East 79th St., Cleveland, Ohio, has published a leaflet on the use and the methods of installing L. C. & M. separator magnets in connection with conveyors.

Pyrometer Protection Tubes. Louis C. Eitzen Co., 280 Broadway, New York, N. Y. A single-page circular lists the sizes and describes the uses of "Pynolag" pyrometer protection tubes manufactured by the Industrial Welded Products Co., Newark, N. J.

Screws. Elco Tool and Screw Corporation, Rockford, Ill. A wall chart has been issued by this company containing tables of dimensions for flat-head, round head and oval-head standard wood screws.

Sharpening Machines. Samuel C. Rogers & Co., 10-16 Lock St., Buffalo, N. Y. A price list for catalog No. 50 covering "Rogers-Buffalo automatic knife grinders and saw sharpeners, saw and knife fitting tools, has been issued. The price list brings up to date the previous catalog which describes the equipment manufactured by the company and which is well illustrated.

Speed Reducers. W. C. Lipe, Inc., 208 South Geddes St., Syracuse, N. Y. An eighteen-page catalog has been issued by this company describing its line of products which includes speed reducers, flexible couplings, electric hoists and spur gears as well as a gear-tooth chamfering machine and a coil winding machine. Many illustrations are included.

Stellite. Haynes Stellite Co., Kokomo, Ind. Circular D-1 describes the line of milling cutter blades manufactured by the company. Many illustrations are included in the booklet.

Stelliting. The Haynes Stellite Co., Kokomo, Ind., has issued a pamphlet describing the process of stelliting of metal parts, in conjunction with the welding process, so as to provide for renewal of surfaces subject to wear and to increase their life. Illustrations and directions show the methods of stelliting the surfaces. The booklet provides a full discussion and treatise on this process.

Tap Holders. Apex Machine Co., Dayton, Ohio. An illustrated circular describes the construction and lists the sizes in which are obtainable the Apex safety friction tap holders.

Turret Lathes. The Warner & Swasey Co., Cleveland, Ohio, has published a fifty-page, 6x9-in. booklet entitled "Modern Tooling Methods for Turret Lathes" by M. E. Lange, production engineer of the company. This is book one of a series of three, and takes up bar work.

The greater part of the material in the booklet has appeared in the *American Machinist* for January and February. The booklet provides practical information and suggestions for the correct handling of turret lathe tool equipment for large- and small-lot production.

The material covers methods and problems of bar work as well as typical bar set-ups and universal bar tools.

Photographs as well as line drawings are given of the principal set-ups described in the booklet. The material is artistically and systematically prepared and the appearance of the booklet is very pleasing.

Calendar of Local Meetings

National Association of Cost Accountants

Philadelphia. March 12. The duties of a treasurer of an industrial company.

Mohawk Valley. March 15. "The Company's Cost Methods and the Uses Made of Cost Records." Visit to a plant at Utica, N. Y.

Hartford. March 16. Visit to plant of International Silver Co. Technical meeting and discussion in the evening.

Los Angeles. March 16. "Forecasting Business Conditions as Applied to Costs," by Harrison C. Hall.

Cleveland. March 17. Costs for Financial Institutions.

Chicago. March 18. "Merchandise Control in the Retail Establishment."

Milwaukee. March 19. "Mechanical Devices for Cost Work."

San Francisco. March 22. Discussion of the subject—"The Cost to Sell."

Scranton. March 23. "Depreciation," Mr. Griesmann.

Boston. March 25. "The Elements of Standard Cost," by R. D. Willard.

American Society for Steel Treating

Hartford. June. Spring sectional meeting.

Society of Automotive Engineers

Southern California. March 12. "Mathematical Analysis of Brake Requirements," by E. Favary and John Wiggers.

Cleveland. March 15. "Research," by C. F. Kettering.

Buffalo. March 16. Studies on the Oscillation of Leaf Springs, N. E. Hendrickson.

Detroit Section. March 25. Production meeting on automobile gearing.

Chicago. March 26. "Development and Trend in Industry," by F. E. Moskovics. Other discussions by H. L. Horning, and R. E. Wilson.

Northern California. March 26. "Gasoline and New Fuel Tests," by W. S. Jones.

American Society of Mechanical Engineers

Rochester. March 12. Joint meeting with the Rochester Engineering Society.

New York. March 17. Joint meeting of the founder societies.

New England Meeting. May 3 to 6. Providence, R. I. Chairman of program committee, Luther D. Burlingame.

Forthcoming Meetings

National Railway Appliance Association. Annual meeting and exhibition, Coliseum and Annex, Chicago, March 8 to 11th. C. W. Kelley, secretary, 845 So. Wabash Ave., Chicago.

National Metal Trades Association. Twenty-eighth annual convention, Hotel Astor, New York, April 15 and 16. Secretary, J. E. Nyhan, Peoples Gas Bldg., Chicago, Ill.

American Welding Society. Annual meeting, Engineering Societies Bldg., New York City, April 21, 22 and 23.

National Foreign Trade Council. Thirteenth national foreign trade convention, Charleston, S. C., April 28, 29 and 30. O. K. Davis, secretary, India House, Hanover Square, New York.

American Gear Manufacturers' Association. Tenth annual meeting, Book-Cadillac Hotel, Detroit, May 13, 14 and 15. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

American Supply and Machinery Manufacturers' Association. Annual convention, Hotel Statler, St. Louis, week of May 17. F. D. Mitchell, secretary, 1819 Broadway, New York.

Society of Automotive Engineers. Summer meeting, French Lick Springs, Indiana, June 1 to 4. John Warner, manager of meetings, S. A. E., 29 West 29th St., New York City.

National Association of Purchasing Agents. Eleventh annual convention and exposition, Ambassador Hotel and Auditorium, Los Angeles, Calif., June 9 to 12. W. L. Chandler, secretary, Woolworth Bldg., New York.

American Railway Association. Annual meeting of the Mechanical Division (Master Car Builders and Master Mechanics), Atlantic City, N. J., June 9 to 16. V. R. Hawthorne, secretary, 431 So. Dearborn St., Chicago.

Railway Supply Manufacturers' Association. Annual convention and exhibit in conjunction with Division V, Mechanical, of the American Railway Association, Young's Million Dollar Pier, Atlantic City, June 9 to 16. J. D. Conway, secretary, 1841 Oliver Bldg., Pittsburgh.

Society of Industrial Engineers. Thirteenth national convention, Bellevue-Stratford Hotel, Philadelphia, June 16, 17 and 18. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago.

American Society for Testing Materials. Haddon Hall Hotel, Atlantic City, N. J., June 21 to 25. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia.

American Society of Mechanical Engineers. Spring meeting, Palace Hotel, San Francisco, Calif., June 28 to July 1. Chairman of convention, Warren H. McBride, the California and Hawaiian Sugar Refining Co., 215 Market St., San Francisco.

American Railway Tool Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 1, 2 and 3. G. G. Macina, secretary, 11402 Calumet Ave., Chicago.

American Railway Tool Foremen's Supply Association. Annual exhibit in connection with the annual convention of the American Railway Tool Foremen's Association, Chicago, Sept. 1, 2 and 3.

American Foundrymen's Association. Second international foundrymen's congress, Detroit, Sept. 27 to Oct. 1, under the auspices of the American Foundrymen's Association. R. E. Kennedy, secretary, 909 W. California St., Urbana, Ill.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—There is noticeable improvement in pig-iron buying for second quarter delivery. No. 2 fdry. So. iron is about $1 per ton under a week ago. Growing firmness appears in the principal hot-rolled steel products and sheets. Scrap is also tending upward, while semi-finished material moves slowly. Mill quotations are practically unchanged from a week ago on the following: bars, $2; plates, $1.80; shapes, $1.90@$2 per 100-lb., Pittsburgh.

Non-Ferrous Materials—Compared with the Feb. 26 level, zinc declined ¼c.; copper, ⅛c.; tin ¼c.; antimony, 1c. per lb. at New York warehouses. Lead remained firm and unchanged. Linseed oil is down 0.5c. per lb. or 3¾c. per gal., f.o.b. New York, since Feb. 25. Furnace coke dropped $1 and foundry, 25c. per ton at Connellsville, during week.

(All prices as of Mar. 5)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	24.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.37
BIRMINGHAM	
No. 2 Foundry	22.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	24.16
Virginia No. 2	29.17
Basic	23.16
CHICAGO	
No. 2 Foundry local	23.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	22.27
Basic	22.27
Bessemer	22.27

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.50
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.45@2.50	3.89	3.25	3.50
No. 12	2.50@2.55	3.94	3.30	3.55
No. 14	2.55@2.60	3.99	3.35	3.60
No. 16	2.65@2.70	4.09	3.45	3.70
Black				
Nos. 18 to 20	3.05@3.15	4.30	3.90	3.90
Nos. 22 to 24	3.10@3.20	4.35	3.95	3.95
Nos. 26 and 27	3.15@3.25	4.40	4.00	4.00
No. 28	3.25@3.35	4.50	4.10	4.10
Galvanized				
No. 10	3.50@3.60	4.50	4.25	4.25
Nos. 12 to 14	3.60@3.70	4.60	4.35	4.35
No. 16	3.75@3.85	4.75	4.50	4.50
Nos. 18 to 20	3.90@4.00	4.90	4.65	4.65
Nos. 22 to 24	4.05@4.15	5.05	4.85	4.80
Nos. 26 and 27	4.20@4.30	5.20	5.10	4.95
No. 28	4.50@4.60	5.50	5.25	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches External	Diameter in Inches Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness Decimal	B.W.G. and Fractions	Outside Diameter in Inches ¼	⅜	½	⅝	1	1¼	1½
		Price per Foot						
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
.065″	16	.19	.20	.21	.22	.23	.25	.27
.083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109″	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.85	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.55	5.60	5.50
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.10
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	50@60%	55%	50%

Electric welding wire, New York, 5/32, 8.25c.; ⅛, 7.85c.; 5/32 to ½, 7.35c. per lb. *Flat, 3/16@¼-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.00
Tin, 5-ton lots, New York			65.50
Lead (up to carlots) E. St. Louis	8.50	New York	9.62½
Zinc (up to carlots) E. St. Louis	7.40	New York	8.50

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	22.00	24.50	26.00
Copper sheets, base	22.75	22.75	22.75
Copper wire, base	19.75	16.50	16.25@16.50
Copper bars, base	22.37½	22.37½	22.37½
Copper tubing, base	24.50	24.50	24.50
Brass sheets, base	19.12½	19.12½	19.12½
Brass tubing, base	23.75	23.75	23.25
Brass rods, base	16.87½	16.87½	16.87½
Brass wire, base	19.62½	19.62½	19.62½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	27.00	27.00	27.02
Zinc sheets (casks)	12.00	12.60@12.95	12.27
Solder (½ and ½), (case lots)	40.62½	41.00	38@42
Babbitt metal, delivered, New York, cents per lb.:			
Genuine, highest grade			81.50
Commercial genuine, intermediate grade			56.00
Anti-friction metal, general service			31.50
No. 4 babbitt (f.o.b.)			14.50
Nickel, f.o.b. refinery, cents per lb.:			
Ingots 31.00 Electrolytic 38.00 Shot			32.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	12.25@12.50	11.25	11.50@12.00
Copper, heavy, and wire	11.50@12.12½	11.50	11.00@11.50
Copper, light, and bottoms	10.00@10.37½	9.50	10.00@10.50
Heavy lead	8.00@8.25	7.50	7.50@8.00
Tea lead	5.50@6.00	5.00	6.50@7.00
Brass, heavy, yellow	7.25@7.75	7.25	7.75@8.25
Brass, heavy, red	9.50@10.00	9.50	8.75@9.25
Brass, light	6.25@6.75	6.00	7.25@7.75
No. 1 yellow rod turnings	8.50@9.00	8.00	7.75@8.25
Zinc	4.75@5.00	4.75	4.50@5.00

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$11.25	$11.45	$11.50
"A" Grade:				
IC,	14x20	8.85	9.40	9.50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.85	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.15@0.22	$0.19	$0.20
Cotton waste, colored, per lb.	.10@.15½	.10	.17
Wiping cloths, washed white, per lb	.18	36.00 per M	.16
Sal soda, per 100 lb. keg	2.25	2.25	2.75*
Roll sulphur, per 100 lb. keg	3.75	3.35	5.00
Linseed oil, per gal., 5 bbl. lots	.83½	.99	.88
Lard cutting oil, 25% lard, per gal.	.55	.50	.48
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.35	.35	29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.04	.0415
Brass rods	per lb	.1687½	.1662½	.1762½
Solder (½ and ½)	per lb.	.4062½	.3925	.42
Cotton waste	per lb.	.15@.22	.15@.22	15@22
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	7.00
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.60
Machine oil	per gal.	.35	.35	.33
Belting, leather, medium	off list	40–5%	40–5%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.56	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.45	1.49
Cloth	3.55	3.55	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		3.00@3.25
Coke, prompt foundry, Connellsville	per net ton		4.50@5.50
White lead, dry or in oil	100 lb. kegs	New York, 15.25	
Red lead, dry	100 lb. kegs	New York, 15.25	
Red lead, in oil	100 lb. kegs	New York, 16.75	

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{7}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x½-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x½-in., 2c. each. Discount 70% for $\frac{5}{16}$-in and smaller and 65% for ⅜-in. and larger.
Case hardened ¼x½-in., 6c. each, less 50%.

Rivets, button heads, ⅜-in., ½-in., 1-in. diam. x2$\frac{1}{16}$-in. to 4½-in. $5.00* per 100 lb. at New York warehouses; c e heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{7}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1½ to 2-in. long, all diameters, 25c.; ⅝-in. dia., 35c.; ¾-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ⅜-in., $7.00* per 100 lb. at New York warehouses; ½-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Fla., Miami—The Dade County Board of Public Instruction, A. Lowers, Supt. of Vocational Education — vocational equipment for proposed high school. Estimated cost $1,000,000.

Ind., Indianapolis — L. G. S. Mfg. Co., 26th and Cornell Sts. (spring clutch device) high speed production machinery. Estimated cost $27,000.

Md., Baltimore—Baltimore & Ohio R.R., W. S. Galloway, Purch. Agt.—18 in. x 8 ft. lathe.

Mich., Sault Ste. Marie — Chippewa County, A. J. Short, Chn. of Road Comn.—machinery for the repair of road equipment for proposed 1 story, 90 x 100 ft. machine shop. Estimated cost $15,000.

Mo., St. Louis—American Heater Corp., Sixth and Carr Sts.—60 in. or over, hand bending brake, 60 in. slip roll up to 14 gauge, deep throat punch press to punch 5-16 hole in ¾ in. steel, 30 in. or longer, grooving machine and beading machine.

Mo., Valley Park — Barbour Boat Co. — hand power shear for slitting 3-16 sheets.

O., Cleveland—Cleveland Punch & Shear Co., 3917 St. Clair Ave., A. L. Bachtel, Purch. Agt.—heavy duty milling machine, equal to 4 or 5 Cincinnati.

Wis., Milwaukee—J. L. Batiste, 594 34th St.—bench lathe.

Wis., Oshkosh — Wilkin-Challoner Co., Mt. Vernon and Nevada Sts. — foundry equipment for proposed 1 story, 80 x 112 ft. foundry. Estimated cost $40,000.

Ont., Parry Soumi—The McGuire-Robinson Radium & By-Products, Ltd., H. F. McGuire, Purch. Agt.—drill and plugger drill.

Opportunities for Future Business

Ariz., Douglas — Phelps-Dodge Corp. awarded contract for the construction of copprell and roaster buildings, rebuilding 3 furnaces and boiler plant. Estimated cost to exceed $1,000,000.

Calif., Beverly Hills—M. A. Wilson, Bradbury Bldg., Los Angeles, awarded contract for the construction of a 5 story, 50 x 150 ft. garage on Canon Drive, here. $150,000.

Calif., Los Angeles — Bd. of Education, will receive bids about March 17 for the construction of 1, 2 and 3 story, 180 x 527 ft. Horace Mann junior high school including a 75 x 150 ft. shop building, etc. Estimated cost $325,000. Edelman & Zimmerman, W. H. Hellman Bldg., Archts. Noted Sept. 24.

Calif., Marysville—Pacific Gas & Electric Co., 245 Market St., San Francisco, plans the construction of a garage and machine shop at A and 3rd Sts., here. Estimated cost $30,000. Private plans.

Calif., Santa Monica—Symphonaer Co., C. F. Winder, Pres., has completed sketches for the construction of a factory on Pico Blvd. Estimated cost $1,000,000. Noted Feb. 25.

Calif., Stockton—Frazier & Co., c/o R. Morrell, Union Bldg., Archt., manufacturers of sheet metal products, awarded contract for the construction of a plant at Church and San Joaquin Sts. $7,964. Noted Feb. 18.

Calif., Vernon—South California Iron & Steel Co., Randolph St., Los Angeles, manufacturers of steel frames, awarded contract for the construction of a 1 story, 62 x 190 ft. factory at 3400 Slauson Ave. Estimated cost $40,000.

Conn., New Britain—North & Judd Mfg. Co., East Main St., awarded contract for rebuilding annealing building. Estimated cost $40,000.

Conn., Waterbury—M. J. Daly & Sons, Inc., 555 Bank St., manufacturers of pipes, valves and fittings, awarded contract for the construction of a 3 story, 42 x 100 ft. addition to shop building. Estimated cost $40,000.

Ga., Atlanta — Willys-Overland, Inc., C. M. LeRoux, Mgr., 469 Peachtree St., awarded contract for the construction of a 3 story, 50 x 132 ft. sales and service building at North Ave. and West Peachtree St. Total estimated cost $600,000.

Ill., Chicago—Crane Co., 836 South Michigan Ave., awarded general contract for the construction of a 3 story, 120 x 475 ft. factory addition at Kedzie Ave. and 41st St.

Ill., Chicago—Jewell Electrical Instrument Co., 1640 Walnut St., manufacturers of voltmeters, ammeters, etc., awarded contract for the construction of a 2 story, 75 x 100 ft. addition to factory. Estimated cost $40,000. Noted Feb. 4.

Ill., Chicago — Mid City Auto Body & Wagon Works, 401 North Morgan St., awarded contract for the construction of a 1 story, 85 x 125 ft. factory. Estimated cost $40,000. Noted Feb. 18.

Ill., Cicero — Stromberg Motor Devices Co., 58-68 East 25th St., Chicago, is having preliminary plans prepared for the construction of a factory at 54th Ave. and 16th St., here. Estimated cost $4,000,000. N. M. Dunning, 304 South Wabash Ave., Chicago, Archt. Leiverman & Hein, 190 North State St., Chicago, Engrs.

Ind., Elkhart — Henry Weis Mfg. Co., W. M. Weis, 1014-1024 Commercial St., Atchison, Kan., manufacturers of sheet metal products, has work under way on the construction of a factory here. Estimated cost $100,000. Noted Feb. 11.

Ind., Indianapolis—Merchants Heat & Light Co., Washington and Meridian Sts., awarded contract for the construction of a garage and storage building. Estimated cost $150,000.

Ind., Muncie — Warner Gear Co., Clerk and Penn Sts., plans the construction of 2 factory buildings. Estimated cost $500,000.

Ky., Paducah—Illinois Central R.R., 135 East 11th Place, awarded contracts for the construction of machine shops, brass foundry, carpenter and paint shops, etc. Total estimated cost $3,000,000.

La., New Orleans — M. H. Goldstein, Hibernia Bank Bldg., Archts., will receive bids until March 15 for the construction of a 5 story garage and wagon works on Gravier St., for J. Thomson & Bros., 233 South Rampart St. Estimated cost $100,000. Noted Feb. 25.

Mich., Dearborn—Ford Motor Co., Stout Metal Airplane Div., plans the construction of a 1 story airplane factory at Ford Airport to replace fire loss. A. Kahn, 1000 Marquette Bldg., Detroit, Archt.

Mich., Detroit—Dept. of Public Works, will soon award contract for the construction of addition to asphalt plant including shop, conveying equipment, etc., at Lynch and French Roads. P. A. Fellows, City Hall, Engr. Noted Feb. 11.

Mich., Detroit—The Vinton Co., 12225 General Motors Bldg., plans the construction of a 2 story, 100 x 140 ft. garage at Dexter Blvd. and Rochester Ave. Estimated cost $150,000. Wiedmaier & Gay, 51 Campau Bldg., Archts.

Mo., Kansas City—L. Drescher, Ambassador Hotel, plans the construction of a 6 story shop and office building at 3724 Broadway. Estimated cost $250,000. R. F. Gornail, Barclay Bldg., 3619 Broadway, Archt.

Mo., St. Louis—Hudson-Frampton Motor Car Co., 4517 Delmar Blvd., awarded contract for the construction of a 1 story, 70 x 242 ft. automobile repair and service station on Enright St. Estimated cost $100,000.

Mo., St. Louis—Vesper-Buick Automobile Co., Grand and Lindall Blvds., awarded contract for the construction of a 2 story, 100 x 215 ft. auto service building at Grand and Winnebago Sts. Estimated cost $150,000. South Side Buick Co., Grand and Potomac Sts., lessee.

Neb., Lincoln—Lincoln Public Service Co., consolidation of Lincoln Gas & Electric Co. and Lincoln Traction Co., plans to expend $1,350,000 for improvements in 1926 including the construction of a new service building, meter shops, store room, garage, etc. at Seventh and L Sts.

N. J., North Bergen (Weehawken P. O.) Atlantic Tank & Barrel Corp., Grand Ave., Hoboken, awarded contract for the construction of a 1 story plant here. Estimated cost $60,000.

N. Y., Brooklyn—Kalton Machine Works, 59 Academy St., Jersey City, N. J., is having plans prepared for the construction of a 2 story factory at 166 34th St., here. Estimated cost $30,000. H. J. Nurick, 44 Court St., Brooklyn, N. Y., Archt.

O., Akron—City, W. F. Peters, plans the construction of a 1 and 2 story, 156 x 200 ft. garage and office building on Johnston St. Estimated cost $150,000. Good & Wagner, Mohawk Bldg., Archts. M. P. Tucker, Municipal Bldg., Engr.

O., Ashtabula—The American Ford & Hoe Co., Keith Bldg., Cleveland, is having plans prepared for additions and alterations to plant here. Estimated cost $40,000.

O., Cincinnati—Cincinnati Mfg. Co., Gest and Evans Sts., manufacturers of metal screens, awarded contract for the construction of a 6 story, 72 x 103 ft. factory. Estimated cost $70,600.

O., Youngstown—John H. Fitch Co., F. C. King, Pres., 304 Mahoning Bank Bldg., awarded contract for the construction of a garage at Phelps and Commercial Sts. Estimated cost $300,000.

Pa., Philadelphia—John W. Watson Co., 24th and Locust Sts., manufacturers of auto accessories, etc., awarded contract for the construction of a 1 story, 124 x 783 ft. manufacturing building at Aramingo Ave. and Tulip and Sanger Sts. Estimated cost $300,000. Noted Jan. 7.

Tenn., Nashville—O. F. Noel Estate, Noel Block, is having plans prepared for the construction of a 5 story garage at Third and Church Sts. Hart, Nevens, Freeland & Roberts, Independent Life Bldg., Archts. and Engrs.

Tex., Cleburne—Gulf, Colorado & Santa Fe Ry. Co., 408 Union Depot Bldg., Galveston, is receiving bids for the construction of a 122 x 517 ft. blacksmith shop, 45 x 228 ft. flue shop, etc., here. Total estimated cost $300,000. W. J. Smith, Archt. F. Merritt, Engr. Noted Jan. 28.

Wis., Milwaukee—Crown Metal Co., 255-257 Washington St., awarded contract for the construction of a 1 story, 40 x 50 ft. addition to shop.

Wis., Racine—Wisconsin Gas & Electric Co., 305 5th St., Racine, affiliated with Milwaukee Electric Railway & Light Co., Public Service Bldg., Milwaukee, is having plans prepared for extensions to gas plant including new meter repair building, storage plant, shops, garage, etc. Estimated cost $500,000.

Wis., Stevens Point—Weber Lifelike Fly Co., 143 Main St., manufacturers of artificial fish bait, is having plans prepared for the construction of a 1 story, 62 x 100 ft. factory on 3rd St. Estimated cost $40,000. F. Spalenka, 434 Normal Ave., Archt.

Man., Winnipeg—T. Eaton Co., Ltd., 190 Yonge St., Toronto, Ont., will receive bids about March 15 for the construction of a 4 story, 100 x 120 ft. garage at 255-257 Carlton St., here. Estimated cost $170,000. J. Woodman, 408 Great West Perminent Loan Bldg., Winnipeg, Man., Archt.